PB-217 829

PROCEEDINGS OF SECOND SESSION OF THE CONFERENCE TO CONSIDER THE ESTABLISHMENT OF WATER QUALITY STANDARDS FOR THE MISSOURI RIVER BASIN INTERSTATE WATERS. STATE OF IOWA, HELD IN COUNCIL BLUFFS, IOWA ON 15-16 APRIL 1969

Federal Water Pollution Control Administration
Washington, D. C.

1969

DISTRIBUTED BY:

NTIS
National Technical Information Service
U. S. DEPARTMENT OF COMMERCE
5285 Port Royal Road, Springfield Va. 22151

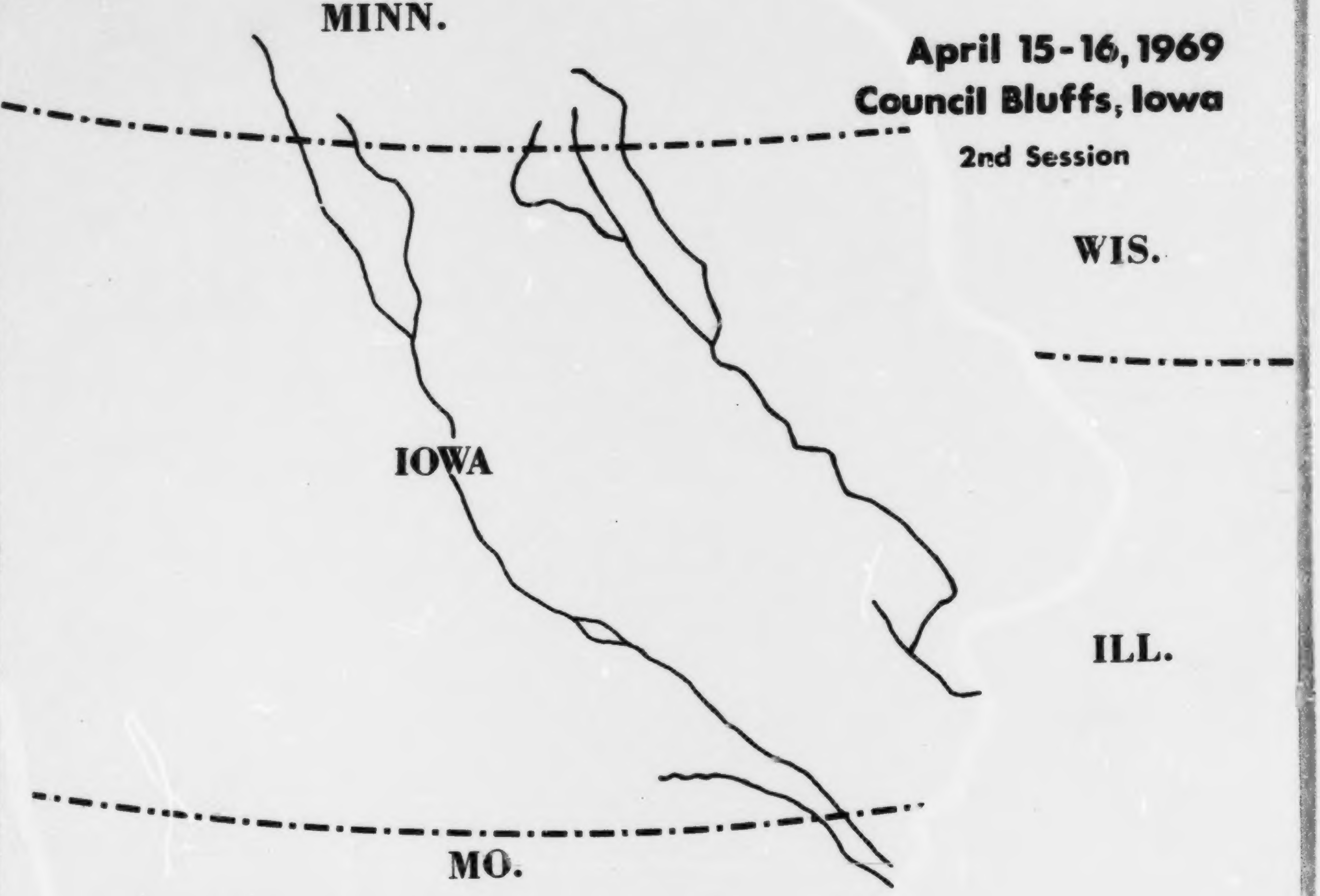
67.2:
90/2
2:M69 0/2

PB 217 829

NTIS

PROCEEDINGS

April 15-16, 1969
Council Bluffs, Iowa
2nd Session



CONFERENCE

To Consider the Establishment of Water Quality Standards for the Missouri River Basin Interstate Waters—State of Iowa.

Reproduced by
NATIONAL TECHNICAL
INFORMATION SERVICE
U S Department of Commerce
Springfield VA 22151

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

766

SECOND SESSION

OF THE

CONFERENCE

TO CONSIDER THE ESTABLISHMENT OF WATER QUALITY STANDARDS FOR THE MISSOURI RIVER BASIN INTERSTATE WATERS - STATE OF IOWA

held in

Council Bluffs, Iowa

April 15 - 16, 1969

TRANSCRIPT OF PROCEEDINGS

I

CONTENTS

	PAGE:
Murray Stein	5
Carl V. Blomgren	15 and 402
Edwin E. Geldreich	269
Gen. C. Craig Cannon	288
T. C. Ferris	295
Dr. Graham Walton	303
Dr. Aaron A. Rosen	307
Robert W. Sharp	316
Kenneth R. Roberts	348
Dr. Clarence M. Tarzwell	372
Bob A. Hegg	391
H. O. Hartung	399
Robert S. Burd	412
Edward Lightfoot	413
William W. Amundson	442
Mrs. George G. Koerber	444
Carl R. Noren	450
Robert C. Russell	451
D. F. Beam	456

CONTENTS

(CONTINUED)

PAGE:

Dr. Robert L. Morris 464

Dr. Roger W. Bachmann 499

R. J. Schliekelman 504

Dr. Jack H. Gakstatter 566

Harry M. Harrison 573

Robert Buckmaster 585

REBUTTAL

Carl V. Blomgren 609

Robert S. Burd 614

Dr. Aaron A. Rosen 618

Edwin E. Geldreich 622

R. J. Schliekelman 625

Melville W. Gray 627

John M. Rademacher 628

Frank L. Carlson 630

- - -

The Second Session Conference to Consider the Establishment of Water Quality Standards for Interstate Waters Subject to the Jurisdiction of the State of Iowa convened at 9:30 o'clock a.m. on April 15, 1969, at the Chieftain Hotel, Council Bluffs, Iowa.

PRESIDING:

Mr. Murray Stein
Assistant Commissioner for Enforcement
Federal Water Pollution Control Administration
Department of the Interior
Washington, D. C.

PARTICIPANTS:

William W. Amundson
City Engineer
City of Sioux City
Sioux City, Iowa

Dr. Roger W. Bachmann
Rural Route #3
Ames, Iowa

D. F. Beam
Vice Chairman, Nebraska Committee
for Pure Air and Water, Inc.
Omaha, Nebraska

Carl V. Blomgren
Director of Office Technical Support
Federal Water Pollution Control Administration
Kansas City, Missouri

Robert Buckmaster
Chairman, Iowa Water Pollution
Control Commission
Des Moines, Iowa

PARTICIPANTS (CONTINUED):

Robert S. Burd
Deputy Assistant Commissioner for Operations
Federal Water Pollution Control Administration
Washington, D. C.

Brig. General C. Craig Cannon
Missouri River Division Engineer
Corps of Engineers
Omaha, Nebraska

Frank L. Carlson
Engineer, Genesee County, Michigan
Drain Commission Pollution Control
Flint, Michigan

T. C. Ferris
Water Hygiene Representative, Environmental
Control Division, Department of Health,
Education, and Welfare, Region IV
Kansas City, Missouri

Dr. Jack H. Gakstatter
State Hygienic Laboratory - Des Moines
Des Moines, Iowa

Edwin E. Geldreich
Reserach Microbiologist
Bureau of Water Hygiene
U. S. Public Health Service
Cincinnati, Ohio

Melville W. Gray
Assistant Director of Environmental
Health Services, Kansas State
Department of Health
Topeka, Kansas

Harry M. Harrison
Iowa State Conservation Commission
Des Moines, Iowa

H. O. Hartung
President, Missouri River Public
Water Supplies Association
University City, Missouri

PARTICIPANTS (CONTINUED)

Bob A. Hegg
Sanitary Engineer, Missouri Basin Region
Federal Water Pollution Control Administration
Kansas City, Missouri

Mrs. George G. Koerber
Director and State Chairman for Water
Resources, League of Women Voters of Iowa
Ames, Iowa

Edward Lightfoot
Missouri Water Pollution Board
Jefferson City, Missouri

Dr. Robert L. Morris
Associate Director, Iowa State
Hygienic Laboratory - Ames
Ames, Iowa

Carl R. Noren
Director, Missouri Department
of Conservation
Jefferson City, Missouri

John M. Rademacher
Regional Director, Missouri Basin Region
Federal Water Pollution Control Administration
Kansas City, Missouri

Kenneth R. Roberts
Fishery Biologist, Bureau of Commercial
Fisheries, U. S. Department of the Interior
Ann Arbor, Michigan

Dr. Aaron A. Rosen
Chief, Waste Identification and Analysis
Activities, Advanced Waste Treatment Research
Laboratory, Federal Water Pollution Control
Administration, Cincinnati, Ohio

Robert C. Russell
Executive Secretary, Iowa Division
Izaak Walton League of America
Iowa City, Iowa

PARTICIPANTS (CONTINUED):

R. J. Schliekelman
Technical Secretary, Iowa Water
Pollution Control Commission
Des Moines, Iowa

Robert W. Sharp
Regional Supervisor, Division of Fishery
Services, Bureau of Sport Fisheries &
Wildlife, Minneapolis, Minnesota

Dr. Clarence M. Tarzwell
Director, National Marine Water Quality
Laboratory, Federal Water Pollution Control
Administration, West Kingston, Rhode Island

Dr. Graham Walton
Chief, Technical Services, Bureau of
Water Hygiene, U.S. Public Health Service
Cincinnati, Ohio

ATTENDEES:

Larry E. Albaugh
Spencer Packing Company
Spencer, Iowa

Lee Albaugh
Water Pollution Commission
Charles City, Iowa

L. E. Allen
Izaak Walton League of America
Great Trails Chapter
Council Bluffs, Iowa

Jean Amos
Federal Water Pollution
Control Administration
Kansas City, Missouri

Richard D. Anderson
Minnesota Pollution Control Agency
Minneapolis, Minnesota

ATTENDEES (CONTINUED):

Richard K. Ballentine
Federal Water Pollution
Control Administration
Cincinnati, Ohio

W. L. Banks
Federal Water Pollution
Control Administration
Kansas City, Missouri

Wilber A. Blain
Needham Packing Company
Sioux City, Iowa

Harvey L. Brake
Glenwood, Iowa

Dan Brindley
Iowa Health Department
Des Moines, Iowa

Ivan L. Burmeister
U. S. Geological Survey
Iowa City, Iowa

William A. Carle
Iowa Public Service Company
Sioux City, Iowa

J. A. Chittenden
Iowa Beef Packers, Inc.
Dakota City, Nebraska

Carl Chloupek
Federal Water Pollution
Control Administration
Lincoln, Nebraska

Tom Corothers
City of Sioux City Health Department
Sioux City, Iowa

Cal Cox
Soil Conservation Service
Council Bluffs, Iowa

ATTENDEES (CONTINUED):

Thomas O. Dahl
Federal Water Pollution
Control Administration
Kansas City, Missouri

James Diggins
Harrison County
Lagon, Iowa

Charles T. Evitts
Sioux City, Iowa

Ralph Fagan
City of Council Bluffs
Council Bluffs, Iowa

T. A. Filipi
Nebraska Water Pollution Control
Lincoln, Nebraska

Charles A. Geisler
City of Omaha
Omaha, Nebraska

Eugene Gilson
Mills County Conservation Board
Glenwood, Iowa

Charles H. Hajinian
Federal Water Pollution
Control Adminstration
Kansas City, Missouri

Frank E. Hall
Federal Water Pollution
Control Administration
Chicago, Illinois

Paul Harley
Interior Department
Omaha, Nebraska

M. Don Harmon
City Manager
Council Bluffs, Iowa

ATTENDEES (CONTINUED):

John Harrison
State of Nebraska
Omaha, Nebraska

Mrs. Leslie Hendrickson
Sioux Ikettes, Izaak Walton League
Sioux City, Iowa

G. I. Hoilien
Conservation Commission
Waukon, Iowa

Robert C. Horn
Terra Chemicals Int., Inc.
Sioux City, Iowa

P. J. Houser
Iowa State Health Department
Des Moines, Iowa

Calvin Hultman
Congressman Scherle's Office
Council Bluffs, Iowa

Randall S. Jessee
Federal Water Pollution
Control Administration
Kansas City, Missouri

Richard L. Johnson
Iowa Conservation Commission
Missouri Valley, Iowa

John J. Kaplan
Blue Star Foods

Duane E. King
State Conservation Commission
Council Bluffs, Iowa

Richard Knowles
Denison Bulletin
Denison, Iowa

ATTENDEES (CONTINUED):

Anthony L. Kucera
Mississippi Vallen Association
Omaha, Nebraska

Paul Leach
Federal Water Pollution
Control Administration
Kansas City, Missouri

Kenneth M. Mackenthun
Federal Water Pollution
Control Administration
Cincinnati, Ohio

Kenneth A. Mackichan
U. S. Geological Survey
Lincoln, Nebraska

Daniel G. Manning
Corps of Engineers
Omaha, Nebraska

Robert L. Markey
Federal Water Pollution
Control Administration
Kansas City, Missouri

Mrs. Mildred B. May
League of Women Voters
Omaha, Nebraska

Robert A. Maxey
Plant Pesticides Control, ARS
Omaha, Nebraska

William McLaughlin
Iowa Development Commission
Des Moines, Iowa

Othie R. McMurry
Iowa Water Pollution Commission
Des Moines, Iowa

ATTENDEES (CONTINUED):

Art Meger
Hensingion, Durham, Richardson
Omaha, Nebraska

Donald M. Meisner
Simpco
Sioux City, Iowa

Dale J. Mills
Council Bluffs, Iowa

Dennis Mishek
Iowa Department of Health
Des Moines, Iowa

R. B. Moorman
Iowa Wildlife Federation
Ames, Iowa

Dr. D. I. Mount
Federal Water Pollution
Control Administration
Duluth, Minnesota

Ambrose Muenchratt
Iowa Water Pollution
Control Commission
Earling, Iowa

Bill Nelson
Kirkham Michael & Associates
Omaha, Nebraska

William R. Nicholas
Tennessee Valley Authority
Chattanooga,Tennessee

R. G. Paulette
Stanley Consultants
Muscatine, Iowa

H. W. Poston
Federal Water Pollution
Control Administration
Chicago, Illinois

ATTENDEES (CONTINUED):

Thomas J. Powers
Director, Water Quality Standards
Office of Regulatory Programs
Federal Water Pollution
Control Administration
Cincinnati, Ohio

M. E. Reul
Council Bluffs City Water Works
Council Bluffs, Iowa

John Samson
Omaha, Nebraska

Paul Schliesser
Omaha Chamber of Commerce
Omaha, Nebraska

Monte G. Scholten
Spencer Packing Company
Spencer, Iowa

A. D. Sidio
Federal Water Pollution
Control Administration
Cincinnati, Ohio

Walter Sorensen
County Supervisor
Little Sioux, Iowa

James Speers, M.D.
State Department of Health
Des Moines, Iowa

Mrs. Theressa Streitz
League of Women Voters
Council Bluffs, Iowa

Manlee J. Stueve
County Supervisor
Missouri Valley, Iowa

ATTENDEES (CONTINUED):

Harold Summers
S&H Products, Inc.
Audubon, Iowa

Rowena Taylor
Federal Water Pollution
Control Administration
Kansas City, Missouri

A. L. Thomas
Harrison County Engineer
Logan, Iowa

John Thorson
Iowa Power & Light Company
Council Bluffs, Iowa

Bernice Trively
Randolph, Iowa

Rolland A. Trively
Fremont County Sup.
Health Board
Randolph, Iowa

Ed Weinheimer
Conservation Commission
Greenfield, Iowa

Mrs. Ed. Weinheimer
Greenfield, Iowa

W. J. Wells, Jr.
Bell, Galyordt and Wells
Omaha, Nebraska

A. T. Wicks
Federal Water Pollution
Control Administration
Kansas City, Missouri

G. R. Wimmer
Industrial Development Council
Sioux City, Iowa

ATTENDEES (CONTINUED):

Bern Wright
Federal Water Pollution
Control Administration
Washington, D. C.

PROCEEDINGS

OPENING STATEMENT
BY
MR. MURRAY STEIN

MR. STEIN: The conference is open.

We have opened a little late today because of the change in place, and I hope everyone was able to get here.

This conference to consider the establishment of water quality standards is being held under the provisions of Section 10 (c)(2) of the Federal Water Pollution Control Act as amended.

It covers the waters of the Mississippi River, Missouri River, and designated tributaries of these waters subject to the jurisdiction of Iowa which are considered interstate waters under the Federal act.

This is the Second Session of the conference, as we had one last week in Davenport, Iowa. An official notice of the conference was entered into the record there. I don't think it will be necessary to keep that notice, but if anyone has any questions about the jurisdiction of the conference or the rivers which are included, which I think comes out of the reports as we go ahead, then get in touch with Mr. Jessee and copies of the notice will be made available to you so you can see all the particulars.

The conference today will deal with the Mississippi River basin--or Missouri--

MR. SAMSON: You mean the Missouri River basin, don't you, Mr. Stein?

MR. STEIN: Thank you. I appreciate that assist from Nebraska. Otherwise you wouldn't be here.

MR. SAMSON: We are listening to you.

MR. STEIN: Right. That shows how well we are doing.

It will be the Missouri River basin and the tributaries of the basin.

The water quality standards established by the State of Iowa in accordance with Section 10 (c)(1) of the Federal Water Pollution Control Act to be applicable to these waters have been determined in part not to be consistent with the protection of the public health and welfare, the enhancement of the quality of the water, and the purpose of the Federal Water Pollution Control Act, as provided by Section 10 (c)(3) of that Act, with particular reference to:

1. The treatment requirements and implementation plan for waste discharges to the Mississippi and Missouri Rivers;

2. The requirements for disinfection of controllable waste discharges which may be sources of bacteriological pollution;

3. The temperature criteria for the interstate waters of the States other than the Mississippi and Missouri Rivers.

Therefore, in accordance with the provisions of the Federal Water Pollution Control Act, the Secretary of the Interior, in a letter dated January 16, 1969, to Governor Ray of Iowa, has called this conference to consider the establishment of water quality standards applicable to the above interstate waters subject to the jurisdiction of the State of Iowa.

Notice of this conference has been served to appropriate parties as described in Federal regulations and notice of this conference has been published in the

Federal Register.

The parties to this conference are representatives of Federal departments and agencies, interstate agencies, States, municipalities and industries who are contributing to, affected by, or have an interest in the water quality standards for the waters to be covered by the conference and who register their intent to be parties at the conference sessions, and such other persons whom the Chairman, upon application and good cause shown, admits as parties to the conference.

If anyone wants to be a party to the conference or speaker to the conference, he should fill out one of the slips and so indicate and we will try to accommodate him.

My name is Murray Stein. I am from headquarters of the Department of the Interior in Washington and the representative of Secretary Hickel.

A word about the procedures governing the conduct of this conference.

This is the first conference of its kind. The first session in Davenport last week was the very first one and this is the second. I think the procedures, therefore, may be a little new to a lot of professional people who are attending.

So if you have any questions on the conference, I would suggest that you get in touch with Mrs. Rheta Piere--stand up, Mrs. Piere, so they can see you--our National Conference Coordinator, and she can supply the answers or she will find a person who can supply the answers.

Under the law, as you can see, we have a lot of parties to the conference, so we have to depend on everyone's cooperation and good will if we are going to run an equitable and fair hearing, which is our purpose here today--to do this in as fair and as equitable a way as we can. We substantially and I think almost completely achieved that at Davenport. I hope we will be equally successful here. I am talking just about the procedural matters now. But if we are going to be successful, it depends on your cooperation with this large group.

The Federal Water Pollution Control Administration has arranged for the presentation of material concerning the quality of the waters to be covered by the conference, the uses, both existing and potential, of such waters, and the criteria necessary to protect such uses, the person or persons, if any, contributing or discharging any matter affecting the quality of such waters, and remedial measures, if any, recommended by the Federal Water Pollution Control Administration. Each party to the conference will be given an opportunity to make a statement concerning the water quality standards for the waters covered by the conference, and I hope we will confine the remarks of this session to the Missouri River and its tributaries.

An opportunity after all the parties have been heard to make a further statement will be afforded to any of the parties to the conference and this will include rebuttal of other parties' views and an opportunity to make recommendations for water quality standards in either a first or subsequent statement.

I think the procedure last week indicated that with a group of this size, if you have the fortitude to stay here long enough for the rebuttal period, that we can afford everyone an opportunity to not just appear once in rebuttal. If he feels it necessary to appear more than once, twice or three times, I think we may be able to afford that opportunity so we can get a full record and everyone will have a chance to say what he feels he has to say without being cut off. The only thing, again, that I have to ask, please use your own discretion and conscience and self-restraint to be sure that the material is relevant and germane to the issue. I think unless we all do that, we are not going to be too successful.

Now, as Chairman, if it becomes necessary, I may limit the presentations so that repetitious and irrelevant statements may not come in. We did not have to do that last week. I hope we won't have to do it here

A written record and verbatim transcript is being made by Mrs. Virginia Rankin, and subsequent to the conference the conference Chairman will submit to the Secretary of the Interior the verbatim conference transcript, including all charts, tabulations and similar data, and then the Secretary, of course, will take any action which is indicated under Federal law to proceed with the establishment of the standards.

I would suggest that all speakers and participants come to the podium and identify themselves for purposes of the record. For the purpose of aiding the reporter in making the transcript, we would ask you, even if your name is called, to introduce yourself and give your affiliation from the podium before you give the statement.

We also have just one live microphone here. I think with using a little common sense and discretion we can get by with it. You have to recognize that if the Chair wants to speak or if you are speaking up here that we both have to share the microphone.

As a follow-up of last week's conference, we have a telegram received from Mrs. Fred Wupper, President of the League of Women Voters of Nebraska, which we would like to put in the record.

"The League of Women Voters of Nebraska support the statement of the League of Women Voters of Iowa to require secondary treatment of sewage from cities towns and communities along the Missouri River."

In addition to that we have a statement submitted by Mrs. George G. Koerber, State Chairman, Water Resources, League of Women Voters of Iowa, who would like this appended to the first session, and she says:

Opening Statement - Mr. Stein

"In reply to the speaker who immediately followed the presentation by the League of Women Voters of Iowa, we would like to add the following comments to the record.

"The League of Women Voters has been active to support public referenda to construct sewage treatment facilities. For example, the League in Illinois supported the Natural Resources Development Bond Act of 1968 and is presently working for submission of a similar proposal to the voters of Illinois. The Leagues in the Northshore Sanitary District were particularly in their recent efforts for a $35 million bond issue to provide advanced treatment. This bond issue carried only in League communities and fortunately by a sufficient majority so that it carried within the District as a whole. These examples in the speaker's own State should suffice to show that the League takes action to pass public referenda for funds to provide the degree of treatment the organization believes is necessary."

I believe Mrs. Koerber is in the room?

MRS. KOERBER: Yes.

MR. STEIN: I wonder if with your

permission I can make one suggestion. I understand your reluctance to name another State, but we have to preserve the record. No one knows who this refers to. I assume this refers to Illinois, is that correct?

MRS. KOERBER: Yes, to Mr. Morton.

MR. STEIN: Yes, all right.

Now, I also have one other statement from Roger W. Bachmann, PhD., Rural Route 3, of Ames, Iowa. Before I put this in the record, I would suggest that I might give a copy of this to perhaps Mr. Schliekelman or Mr. Rademacher for their consideration, and if they have no comment I will just put it in the record. But I think this raises a technical question, and I do not want to put this in the record without giving both these groups an opportunity to look at this. (See p. 499 for statement.)

With that, we will call on the Federal Government to make a presentation. Mr. Carl Blomgren.

STATEMENT BY CARL V. BLOMGREN
DIRECTOR OF OFFICE TECHNICAL SUPPORT
MISSOURI BASIN REGION, FEDERAL WATER POLLUTION CONTROL ADMINISTRATION,KANSAS CITY, MISSOURI

MR. BLOMGREN: Mr. Chairman, I am Carl Blomgren, Missouri Basin Region, Federal Water Pollution Control Administration.

This statement summarizes the report entitled, "Water Quality Standards Conference - State of Iowa, Iowa Interstate Waters of the Missouri River Basin," convening April 15, 1969, which was transmitted to the Iowa Water Pollution Control Commission on March 19, 1969. I request, Mr. Chairman, that a corrected copy of this report be admitted to the record and I hereby hand the amended copy to the conference reporter.

MR. STEIN: Do you want the whole report put in the record?

MR. BLOMGREN: If you want that, Mr. Chairman.

MR. STEIN: That will be done.

(Which said report is as follows:)

Copy No 1

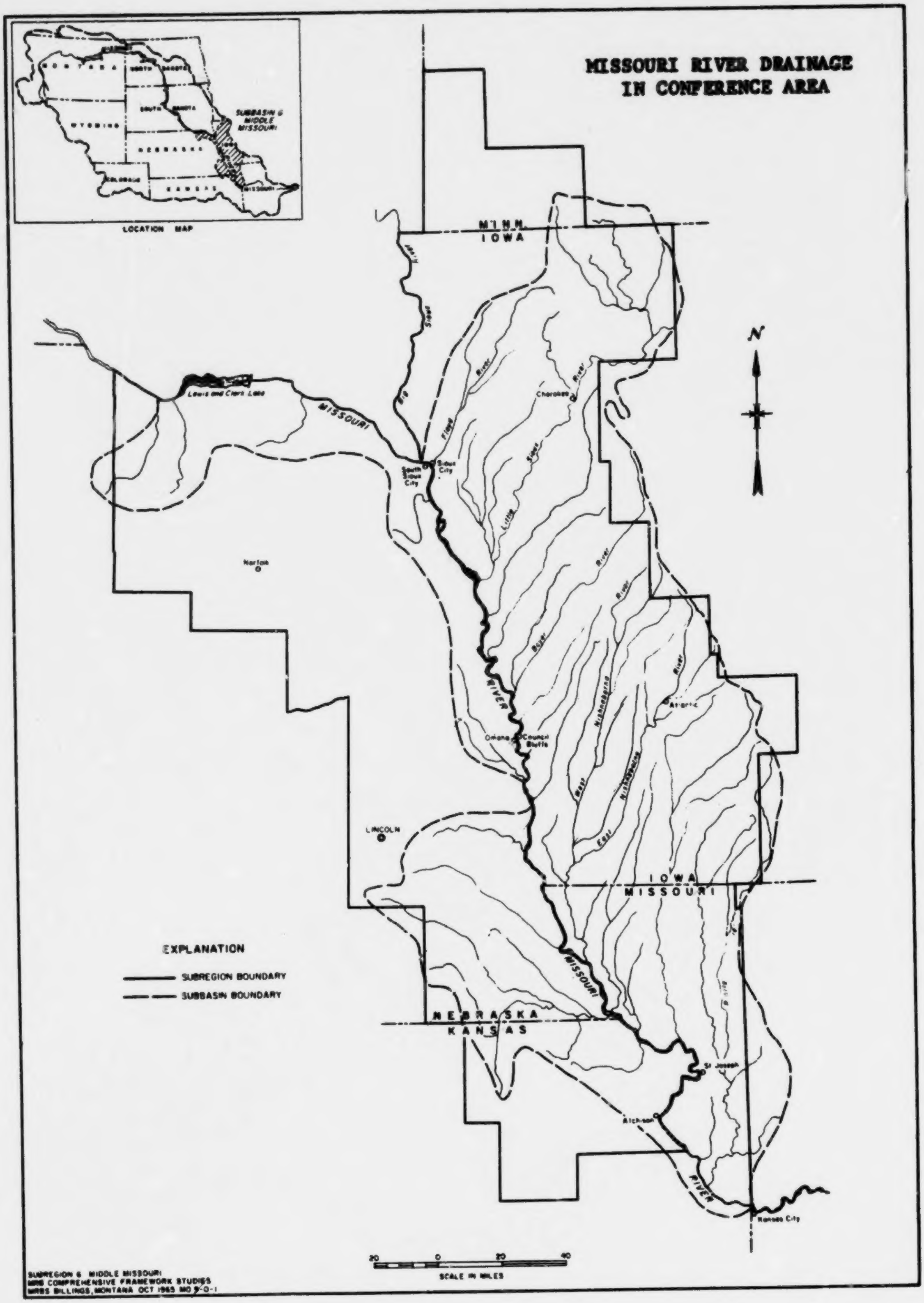
WATER QUALITY STANDARDS CONFERENCE

state of IOWA

Iowa Interstate Waters
of the
Missouri River Basin
convening:
April 15, 1969
Council Bluffs, Iowa

N
W
CLEAN WATER
E
S

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
MISSOURI BASIN REGION



MISSOURI RIVER DRAINAGE IN CONFERENCE AREA

LOCATION MAP
MONTANA
NORTH DAKOTA
SOUTH DAKOTA
WYOMING
NEBRASKA
COLORADO
KANSAS
MISSOURI
SUBBASIN 6 MIDDLE MISSOURI
N
MINN.
IOWA
Lewis and Clark Lake
MISSOURI
Big Sioux
Floyd River
Cherokee
Little Sioux River
South Sioux City
Sioux City
Norfolk
Boyer River
West Nishnabotna River
East Nishnabotna
Atlantic
RIVER
Omaha
Council Bluffs
LINCOLN
IOWA
MISSOURI
MISSOURI
NEBRASKA
KANSAS
St Joseph
Atchison
RIVER
Kansas City
EXPLANATION
SUBREGION BOUNDARY
SUBBASIN BOUNDARY
20 0 20 40
SCALE IN MILES
SUBREGION 6 MIDDLE MISSOURI
MRB COMPREHENSIVE FRAMEWORK STUDIES
MRBS BILLINGS, MONTANA OCT 1965 MO 9-0-1

TABLE OF CONTENTS

		Page
I.	INTRODUCTION	I-1
	A. Purpose	I-1
	B. Authority	I-1
	C. Scope	I-2
II.	SUMMARY	II-1
III.	BACKGROUND	III-1
	A. Description of Area	III-1
	B. Economy	III-1
	C. Hydrology	III-7
IV.	WATER USES, WASTE SOURCES AND WATER QUALITY	IV-1
	A. Water Uses	IV-1
	B. Existing Waste Sources	IV-14
	C. Impact of Water Quality on Use	IV-32
	D. Monitoring	IV-41
V.	QUALITY CRITERIA NECESSARY TO SUPPORT EXISTING AND FUTURE WATER USES	V-1
	A. Treatment	V-1
	B. Disinfection	V-1
	C. Temperature	V-1
	D. Nondegradation	V-2
	E. Radioactivity	V-3
	F. Standards of Related States	V-3
VI.	RECOMMENDATION	VI-1
VII.	APPENDIX	VII-1

I. INTRODUCTION

A. Purpose

The Secretary of the Department of the Interior directed, by notice of March 5, 1969, that sessions of a conference be held in Davenport and Council Bluffs, Iowa, on April 8 and 15, 1969, respectively, to consider the establishment of water quality standards for the interstate waters under control of the State of Iowa.

B. Authority

The water quality standards established by the State of Iowa in accordance with Section 10(c)(1) of the Federal Water Pollution Control Act, as amended (33 U.S.C. 466 et seq.) are determined in part not to be consistent with the protection of the public health and welfare, the enhancement of the quality and value of the water and the purpose of the Act as provided by Section 10(c)(3) of that Act.

Section 10(c)(2) of the Federal Water Pollution Control Act, as amended (33 U.S.C. 466 et seq.) provides that, should the Secretary of the Interior find the water quality standards adopted by the State do not protect the public health or welfare, enhance the quality of the water and serve the purposes of this Act (The Federal Water Pollution Control Act), taking into consideration their use and value for public water supplies, propagation of fish and wildlife, recreational purposes, and agricultural, industrial and other legitimate uses, he may, after reasonable notice, call a conference of representatives of appropriate Federal departments and agencies, interstate agencies, State, municipalities and industries involved prior to preparing regulations setting forth standards of water quality to be applicable to the interstate waters or portions thereof.

In accordance with the provisions of the Act, the Secretary of the Interior has called this conference to consider the establishment of water quality standards relative to the three excepted items below:

1. The treatment requirements and implementation plan for waste discharges to the Missouri and Mississippi Rivers;

2. The requirements for disinfection of controllable discharges which may be sources of bacteriological pollution;

3. The temperature criteria for the interstate waters of State other than the Missouri and Mississippi Rivers.

C. Scope

The interstate waters subject to the jurisdiction of the State of Iowa are as follows:

The waters of the Missouri River, Chariton River, Middle Fork Medicine River, Weldon River, Little River, Thompson River, East Fork of the Big River, Grand River, Platte River, East Fork of the 102 River, Middle Fork of the 102 River, Nodaway River, West Tarkio

River, Tarkio River, Nishnabotna River, Little Sioux River, Big Sioux River, Rock River and Kanaranzi Ditch. These waters are shared jointly with other States. The scope of this report, while limited to the Missouri River Basin waters in Iowa, has included for the purposes of clarification the impact of water quality in these interstate streams on the water uses and water quality standards of the adjoining States.

II. SUMMARY

The following summarizes the more extensive text and appendices of this report.

A. The area of Iowa covered by Part II of the Water Quality Standards Conference is approximately 17,000 square miles or about 30 percent of the land area of the State. This area supports about 600,000 people. The population is projected to remain relatively stable although people will migrate from rural to urban areas. Agriculturally associated enterprises constitute the backbone of the economy with meat packing being the largest industrial water user and waste producer.

B. Municipal and industrial wastes amounting to approximately 1,500,000 population equivalents (P.E.) are discharged into the waters draining to the Missouri River System.

C. The 30 sewer systems in Iowa municipalities in the Missouri Basin discharging waste to interstate streams handle a total connected waste loading of 483,000 population equivalents. Eighteeen of these sewer systems handling less than 15 percent of the total connected loading, provide secondary treatment. Eight of the systems handling 85 percent of the loading provide only primary treatment. Two discharge to adjoining municipalities. Wastes collected by the other two systems are discharged without treatment.

D. Of 167 industries in the conference area covered by this report, 9 have direct discharges to streams. The design organic waste loadings before treatment is reported to be 342,000 population equivalents and with treatment estimated to remove 85 percent of the BOD, with the discharge P.E. approximately 50,000. A complete industrial waste inventory based upon plant surveys is not available.

E. In addition to the wastes generated by the resident population and direct industrial activities, there is a significant animal waste problem. It is estimated that at least 3,300,000 cattle and calves and 6,100,000 hogs and pigs were on farms. These animal wastes have a population equivalent of 65,000,000 and can cause oxygen depletion, bacterial and nutrient pollution problems, and esthetic degradation in a stream.

F. The number of cattle--at present over five times--and the number of hogs and pigs--almost ten times--the human population of the study area is expected to increase substantially in the next decade. Unless controlled, the wastes produced can be expected to increase bacterial and nutrient levels in the tributary streams and the main stem of the Missouri.

G. Sediment is a major pollutant in the Missouri River Basin. Uncontrolled runoff in the Iowa portion of this Basin contributes substantial amounts to the annual load.

H. Investigations of existing water use by Department of the Interior personnel have identified eight categories of beneficial uses. Of these eight categories, public water supplies, recreation, navigation, wildlife habitat, and commercial fishing are considered to have the greatest potential for expansion.

I. The Missouri River on the western boundary of Iowa probably has the greatest potential for recreation development in the Conference area. There are over 30 known developed recreation areas along the Missouri

River in Iowa. The Corps of Engineers has proposed 35 recreation sites for construction between Sioux City and Rulo, Nebraska.

J. High bacterial densities have been observed in the entire reach of the Missouri River from Sioux City to St. Joseph. The bacterial densities exceed the permissible limits which have been accepted by common practice for water supply and recreation use to protect the public health and welfare.

K. During dry weather streamflow conditions over 85 percent of the total coliform densities in the River are attributable to municipal waste effluents. Calculations of the effect of two-stage disinfection and secondary treatment with disinfection on the coliform densities demonstrate that concentrations of less than 10,000 organisms per 100 ml can be obtained.

L. High densities of bacteria and high concentrations of nitrogen and phosphorous are found in Iowa tributaries to the Missouri River, especially during periods of storm water runoff. Much of this is attributable to intense agricultural land use with the consequent use of fertilizers and the deposition of animal wastes on land.

M. Survey results from the main stream stretch of the Missouri River in Iowa identified adverse changes in water quality. Turbidity increased four-fold in the length of reach surveyed and cyanides and phenols were found.

N. Biological investigations revealed predominately clean water organisms and associated aquatic life above Sioux City. However, a consistent increase in pollution tolerant organisms and biota were observed in many stretches of the river between Sioux City and St. Joseph.

O. The main stem of the Missouri is highly regulated with flow characteristics determined by navigational and flood control needs. Hydrologically, 40 percent of the tributaries in Iowa are intermittent. The balance of the streams have measurable low flows except in their headwaters. It is indicated, therefore, that the latter group of streams could support a fishery.

P. Public water users relying on the Missouri River as a source of supply report problems associated with turbidity, ammonia, coagulation, taste and odors.

Q. Recreational activities on the main stem include boating, water skiing, swimming and wading. These activities are directly affected by presence of floating material and grease balls, high bacterial densities, dissolved organics and turbidity. Samples of water taken in the survey had as high as 2000 bacteria per drop.

R. Esthetic values of the waters in this area are reduced due to turbidity, floating materials, and other effects which reduce or eliminate the opportunity for development of spectator oriented activities, e.g., boat or canoe races, etc.

S. Tainting of fish flesh has been reported by commercial and sport fishermen in many areas of the main stem of the Missouri River.

T. Fouling of fishnets and lines with grease is common below major municipal and industrial waste outlets. Similarly, boat hulls of recreational watercraft are fouled with grease and scum.

U. Every State which borders on the Missouri River, except for Iowa has adopted as part of its Standards, a minimum requirement for secondary treatment or its equivalent for wastes discharged into the Missouri River. This provision, for secondary or equivalent treatment, has been enacted by the States of South Dakota, North Dakota, Kansas, Nebraska, Missouri, and Montana. Iowa Standards require secondary treatment on all streams except the Missouri and Mississippi Rivers.

III. BACKGROUND

A. Description of Area

The conference area covered by the report includes the drainage area of the Big Sioux River below Sioux Falls and the Missouri River from Sioux City, Iowa, downstream to the Iowa-Missouri state line. This portion of western Iowa includes slightly more than 17,000 square miles. The average annual precipitation in this area ranges from 25 to 34 inches and the annual temperature ranges from -40 to 115° Fahrenheit.

The topography is varied, ranging from broad fertile flood plains to bluffs bordering the flood plains (which sometimes reach several hundred feet in height) and lands varying from steep slopes to gently rolling hills.

Transportation routes, including two interstate highways, serve all of the area. Interstate 29, a north-south route extending from Kansas City to Sioux City east of the Missouri River, and Interstate 80, an east-west route, cross in the Council Bluffs and Omaha Standard Metropolitan Statistical Area (SMSA). Airlines, railroads and pipelines also serve the area in both east-west and north-south directions. Navigation on the Missouri River extends from St. Louis to Sioux City.

B. Economy

1. Past and Present

Total population of the conference area has increased steadily since World War II. The conference area and the entire State of Iowa have experienced a decrease in farm population during this period.

The rate of urban growth, however, has exceeded the decrease in farm population resulting in a net increase in total population.

While the cities of Sioux Falls and Omaha are not in the conference area, they do influence the area's economy and, therefore, must be considered. A total of about 1.3 million people influenced the area's economy in 1960. About 600,000 people live in this portion of the conference area and 35 percent live in rural areas. However, in the conference area, over one-half of the 1960 population lived in rural areas, reflecting a significant influence of agriculture in the conference area's economy.

The Omaha-Council Bluffs, Sioux Falls, and Sioux City SMSA's, with an average population growth in the period 1940 to 1960 of 36 percent, represented most of the population increase. The large SMSA's along the Missouri River with their population increases from 1940 to 1960 are listed below.

City	Population 1940	Population 1960	% Increase
Omaha-Council Bluffs	325,153	457,873	42
Sioux Falls	57,697	86,575	51
Sioux City	113,463	120,017	6
TOTAL	496,313	664,465	36

Agriculture is a major employer in the conference area. Agriculture and the processing of food products are the backbone of the area's economy. In 1960, over one-fourth of the area's employment were in agriculture and agriculturally related industries. Most of the remaining workers were employed in the service and trade sectors of the economy.

Iowa is located on the western edge of the Corn Belt. The soil is fertile and climatic conditions and topography are favorable for the production of corn and other feed grains. Iowa also produces large numbers of calves and hogs. A good supply of feeder calves, large numbers of hogs, available feed grains and roughage and adequate transportation for distribution to markets, gives Iowa a competitive advantage over other areas in raising livestock. As a result, Iowa is the largest producer of finished cattle and hogs ready for slaughter in the United States.

Farm activity in this area is about 60 percent livestock, dairy and poultry farms with 40 percent cash grain, general or special crop farms. Recent investigations reveal that about 80 percent of total monetary value of farm products are derived from the sale of livestock and livestock products.

About 2 million cattle are on feed in farm feedlots in Iowa. This is about 20 percent of cattle on feed for slaughter in the United States. There are some large commercial operations and many small farm feedlots spread throughout the State. Pottawattomie County ranks first in numbers of cattle on feed in Iowa.

Iowa and its bordering states raise about 60 percent of all the hogs produced in the United States. Iowa markets about 20 million hogs annually, some of which are shipped out of the State for processing. Iowa accounts for about 14 percent of the cattle and 22 percent of the hog production in the U.S.

The large cities of Sioux Falls, Sioux City, and Omaha-Council Bluffs are transportation and service centers for large surrounding rural areas. The service and trade industries continue to increase providing the supporting services required of a business community. These service and trade industries include transportation and storage, retail trade, communications, finance, insurance, etc.

In recent years, many of the meat slaughtering industries have been decentralizing. They are locating throughout the farm belt rather than remaining concentrated in large metropolitan areas. The trend is to locate these slaughter plants near the supply of animals.

Mining activities in the area are limited to construction materials--cement minerals, sand and gravel, stone and clay. Mineral production is concentrated in approximate proportion to the distribution of population, which creates the market for such construction materials.

2. Future

Population and economic growth through 1980 is expected to be governed by historic trends. Growth rates calculated by the Office of Business Economics for this area depict rates of growth, based on the trends of an agricultural economy, lower than those of the Missouri Basin Region or the United States. Mechanization of both farm operations and subsequent processing operations of farm products has led to reduced manpower requirements. In the conference area, these trends have not been balanced by growth trends of other forms of economic activity.

Population projections for these cities are based on the entire urban area or Standard Metropolitan Statistical Area (SMSA) in which they are located. The major growth is expected to be in the Omaha-Council Bluffs SMSA as illustrated in the following table.

SMSA	1960	1980	Percent Increase
Omaha-Council Bluffs	457,873	662,000	45
Sioux Falls	86,575	118,000	36
Sioux City	120,017	139,000	16

Council Bluffs and vicinity are expected to experience a high rate of growth thru 1980. The 1960 population of 65,407 is expected to reach about 84,000 by 1980. This would be a 28 percent increase.

Employment in major urban areas will reflect trade and service concentrations with manufacturing employment being dominated by the processing of agricultural products. Future increases in farm production will be based upon the use of additional capital, increased technology and improved cultural practices.

The largest industrial water user and waste producer is expected to continue to be the meat packing industry. The demand for meat has been increasing and is projected to increase at a rapid rate in the future.

Decentralization of the meat slaughtering industry is expected to continue; however, the large metropolitan areas are also projected to continue to increase in agricultural processing.

Future industrial growth in Council Bluffs should increase at moderate rate. Emphasis will continue to be on trade and service industries--transportation, communication, retail trade, insurance, government, etc. Manufacturing growth will be primarily in the agricultural processing sector. A large livestock slaughtering plant should begin operation during 1969. This will be a cattle slaughtering operation and the waste will be discharged to the city sewerage system. This plant could overload the present treatment facilities to such an extent that expansion of the treatment plant will be necessary. With the continued projected growth of feeding around Council Bluffs, additional livestock slaughtering plants will be needed to process these animals.

New specialized slaughtering plants similar to the one being built in Council Bluffs can compete economically with the outlying plants provided they have an adequate supply of livestock. The Iowa Beef Packers processing plant at Dakota City, Nebraska is a good example of a profitable slaughtering operation that is located near an urban area. This plant is now one of the largest beef operations in the country. The future increase of plants similar to this one appears good.

Sioux City with a larger population and industrial base than Council Bluffs has a slower rate of population growth. The two cities, however, are very similar in their industrial characteristics. Trade and service industries are expected to be the major employer. Food processing is projected to be the largest manufacturing sector by 1980. Both cities have a good supply of livestock in the area with an increasing demand for meat, the opportunities for new livestock slaughtering facilities appear favorable. Projected industrial growth and population increases will probably overload present treatment facilities of both Sioux City and Council Bluffs by 1980.

The manufacture of chemical products, mainly fertilizers, pesticides and other agricultural chemicals, is projected to increase three-fold.

Mineral production in the conference area is confined to non-metallic construction materials and no change is foreseen.

C. Hydrology

That portion of Iowa drained by the Missouri River constitutes nearly one-third of the State's total drainage area or about 17,380 square miles. The drainage basins in the western portion of the State are relatively long and narrow and have a general course from northeast to southwest. Of the interstate streams tributary to the Missouri River, the Big Sioux has the largest drainage area of 9,030 square miles, including 1,970 square miles that are non-contributing. The intrastate streams are typically much smaller with the Boyer River ranking first with drainage of 1,188 square miles. The Floyd and Maple Rivers are the only other large intrastate streams with 921 and 742 square miles, respectively. Size rankings of the remaining basins are shown in Table III-C-1.

Unlike the streams found in the northeast of Iowa, those of the western portion are characterized by periods of excessively low minimum daily discharge. Because groundwater does not play the supporting role that it does in northeastern streams, the base

TABLE III-C-1

DRAINAGE AREA OF IOWA STREAMS GREATER THAN 100 SQUARE MILES IN MISSOURI RIVER BASIN[1]

STREAM	TOTAL DRAINAGE AREA
Big Sioux River	9030
Little Sioux River	4507
Nishnabotna River	2819
Rock River	1688
Boyer River *	1188
Nodaway River	1182
Floyd River *	921
Chariton River	817
Maple River *	742
Thompson River	729
Soldier River *	445
Platte River	282
Mosquito Creek *	267
Weldon River	240
West Fork Hundred and Two River	212
Kanaranzi Creek	205
Tarkio River	206
Grand River	206
Pidgeon River *	165
East Fork Hundred and Two	111
Sixmile Creek *	108
Little River	102

* Non-Interstate waters. Those without asterisk show only drainage area at Iowa State line.

1/ Modified from "Drainage Area of Iowa Streams" by O. J. Larimer, December 1957, and U.S.G.S. Water Supply Papers. Those interstate streams referred to in the Secretary's letter but less than 100 sq. miles are: West Tarkio Creek, 92.5 sq mi.; Middle Fork Hundred and Two 62.1; East Fork of Big Creek, 13.4; and Middle Fork Medicine Creek, 13.3.

flows of the streams in western and southern Iowa are much lower. Consequently, they are dry for days and in some cases even for weeks. The intermittent streams with average discharge below 100 cubic feet per second (cfs) are affected the most in periods of even moderate drought. Table III-C-2 lists eight such streams with "minimum daily discharges" as well as "7-day lowest mean discharges." Some streams have minimum daily discharges of zero cfs during several weeks throughout the period of record. Similarly in periods of severe drought, streams having an average discharge of several hundred cfs are greatly affected and often have minimum daily discharge of only 1 or 2 cfs.

Of all the Iowa tributaries of the Missouri River, only the Little Sioux River near Turin had a 7-day lowest mean discharge exceeding 20 cfs. This flow was estimated on a five year period of record. Nearly 80 percent of all streams with flow measurement showed 7-day lowest mean values of less than 3 cfs and half of these had days with 0 cfs. The periods of record varied as shown in Table III-C-2.

A 7-day, 10-year low flow period has been adopted by the Iowa Water Pollution Control Commission as the criteria both for the design of waste treatment facilities and the minimum flow to which the criteria part of the water quality standards would be applicable. This period shows the capricious nature of Iowa streamflows in relation to applying valid water quality criteria and possible treatment requirements. Table III-C-3 lists the most important rivers and shows a 1, 7 and 30

Table III-C-2

Interstate and Intrastate Streams
of the
Missouri Basin in Iowa

	Drainage Area Sq. Mi.	Period of Record Years	7-Day Lowest Mean Discharge (cfs) for period of record	7 Day Highest Mean Discharge (cfs) for period of record	Minimum Daily Discharge (cfs)	Maximum Discharge (cfs)	Average Discharge (cfs)
1. Rock River near Rock Valley, Iowa	1600	15	0.0	13,800	0.0 Feb. 1959	19,200 June 1954	303
2. Dry Creek at Hawarden, Iowa	48.4	15	0.0	742	0.0 many times in many yrs.	10,900 June 1953	8.23
3. Big Sioux River at Akron, Iowa	9030	35	9.3	35,300	7.0 Feb. 1936	49,500 Apr. 1960	848
4. Perry Creek at 38th Street, Sioux City, Iowa	65.1	18	0.0	844	0.0 many times in many yrs.	1,780 Mean in 1960	17.2
5. Floyd River at James, Iowa	882	28	1.0	9,330	1.0 Aug. 1936 Feb. 1959	71,500 June 1953	182
6. West Fork Ditch at Holly Springs, Iowa	399	24	0.5	3,420	2 July & Aug. 1956	10,000 Mar. 1960	98.8
7. Little Sioux River near Lakefield, Minn.	17.1	14	0.0	221	0.0 many days in most yrs.	2,550 June 1953	3.88
8. Little Sioux River at Correctionville, Iowa	2500	36	4.6	14,100	2.6 July 1936	20,900 June 1954	667
9. Little Sioux River near Kennebel, Iowa	2738	24	12.1	14,400	11.0 Oct. 1956	16,400 Mar. 1960	783
10. Maple River at Mapleton, Iowa	669	22	2.6	5,920	0.0 Sept. 1945	15,600 June 1954	233
11. Little Sioux River near Turin, Iowa	3526	5	22.0	17,700	0.0 Sept. & Oct.'39 Sept. & Oct. 1940	23,900 Mar. 1960	1109

Table III-C-2 (Cont'd)

Interstate and Intrastate Streams of the Missouri Basin in Iowa

	Drainage Area Sq. Mi.	Period of Record Years	7-Day Lowest Mean Discharge (cfs) for period of record	7-Day Highest Mean Discharge (cfs) for period of record	Minimum Daily Discharge (cfs)	Maximum Discharge (cfs)	Average Discharge (cfs)
12. Boyer River at Logan	871	31	2.0	7,250	1.5 July 1938	23,600 June 1957	303
13. Soldier River at Pisgah, Iowa	407	23	2.0	3,100	2.0 Jan. 1945	22,500 June 1950	127
14. Indian Creek at Council Bluffs, Iowa	7.99	9	0.0	20.3	0.0 many years	2,200 July 1958	1.48
15. Waubonsie Creek near Bartlett, Iowa	30.4	17	0.0	572	0.0 many times in 1954-1959	14,500 May 1950	11.6
16. Mule Creek near Malvern, Iowa	10.6	9	0.0	58.7	0.0 Jan. 1956	2,070 Aug. 1954	4.22
17. West Nishnabotna River at Randolph, Iowa	1326	15	10.6	7,720	10.0 Dec. 1955	29,600 May 1960	508
18. Davids Creek near Hamlin, Iowa	26	11	0.0	361.4	0.0 many days in 1952-1956	22,700 July 1958	10.5
19. East Nishnabotna River at Red Oak, Iowa	894	30	8.1	6,800	6.0 Aug. 1936	36,200 June 1947	352
20. Nishnabotna River above Hamburg, Iowa	2806	36	9.9	24,700	4.5 Aug. 1934	55,500 June 1947	954
21. Nodaway River at Clarinda, Iowa	762	29	1.3	8,090	1.0 Sept. 1918	31,100 June 1947	298
22. 102 River near Maryville, Mo.	500	31	0.1	5,640	0.0 Aug. & Sept. 1934 & Jan. 1954	14,200 June 1947	198

Table III-C-2 (Cont'd)

Interstate and Intrastate Streams
of the
Missouri Basin in Iowa

	Drainage Area Sq. Mi.	Period of Record Years	7-Day Lowest Mean Discharge (cfs) for period of record	7-Day Highest Mean Discharge (cfs) for period of record	Minimum Daily Discharge (cfs)	Maximum Discharge (cfs)	Average Discharge (cfs)
23. Platte River near Agency, Mo.	1760	36	0.0	27,300	0.0 Oct. 1956 July-Aug. 1934	50,000 June 1947	817
24. Grand River near Gallatin, Mo.	2250	39	--	--	2.2 June-Oct. 1956	69,100 June 1947	1082
25. Chariton River near Centerville, Iowa	708	21	0.2	--	0.1 Oct. 1938 Oct. 1940	21,700 June 1946	336
26. Thompson River at Davis City, Iowa	701	25	1.2	--	0.1 June 1956	21,300 June 1947	346
27. Weldon River near Mercer, Mo.	246	20	--	--	0.0 many days in '40-'41, '44; '53-'58.	50,000 Aug. 1959	138
28. Tarkio River at Fairfax, Mo.	508	41	0.0	4,350	0.0 Aug. 1934	16,300 June 1942	186

TABLE III-C-3

MAGNITUDE AND FREQUENCY OF ANNUAL LOW FLOW 10 YEAR RECURRENCE INTERVALS

STREAM-GAGING STATION (by drainage area)	DRAINAGE AREA S.Q. MI.	10 YEAR-1 DAY LOW FLOW	10 YEAR 7 DAY LOW FLOW	10 YEAR 30 DAY LOW FLOW
			cfs	
BIG SIOUX RIVER AT AKRON	8851	8.9	15.9	23.9
NISHNABOTNA RIVER (above Hamburg)	2806	7.6	12.6	20.8
LITTLE SIOUX RIVER (at Correctionville)	2500	13.8	18.3	23.0
EAST NISHNABOTNA RIVER (at Red Oak)	894	5.2	7.7	11.6
FLOYD RIVER (at James)	882	1.6	2.7	4.4
BOYER RIVER (at Logan)	871	.8	1.5	3.0
NODAWAY RIVER (at Clarinda)	762	3.7	4.9	6.4
CHARITON RIVER (near Centerville)	708	.1	.2	.3
THOMPSON RIVER (at Davis City)	701	.7	1.2	1.8
MAPLE RIVER (at Mapleton)	669	4.1	5.6	7.4
SOLDIER RIVER (at Pisgah)	407	.9	1.6	2.4
WEST FORK DITCH (at Holly Springs)	399	1.0	1.4	1.9

day, 10-year low flow. It is noteworthy to point out that where differences exist in drainage areas, the anomolies are due to smaller subbasins being partially incorporated or duplicated when shown in a major basin.

Numerous Low-Flow Volume-Frequency Duration Curves are also supplied for eight of the more important tributaries. The selected durations are for 1, 3, 7, 14, 30 and 90 days as well as an annual period. The exceedence frequency of the points plotted for each duration for all stations was based on the formula normally used by the USGS where:

$$\text{Return Period or Recurrence Interval in Years} = \frac{N+1}{M}$$

or

$$\text{Exceedence Frequency per 100 Years} = \frac{M}{N+1}$$

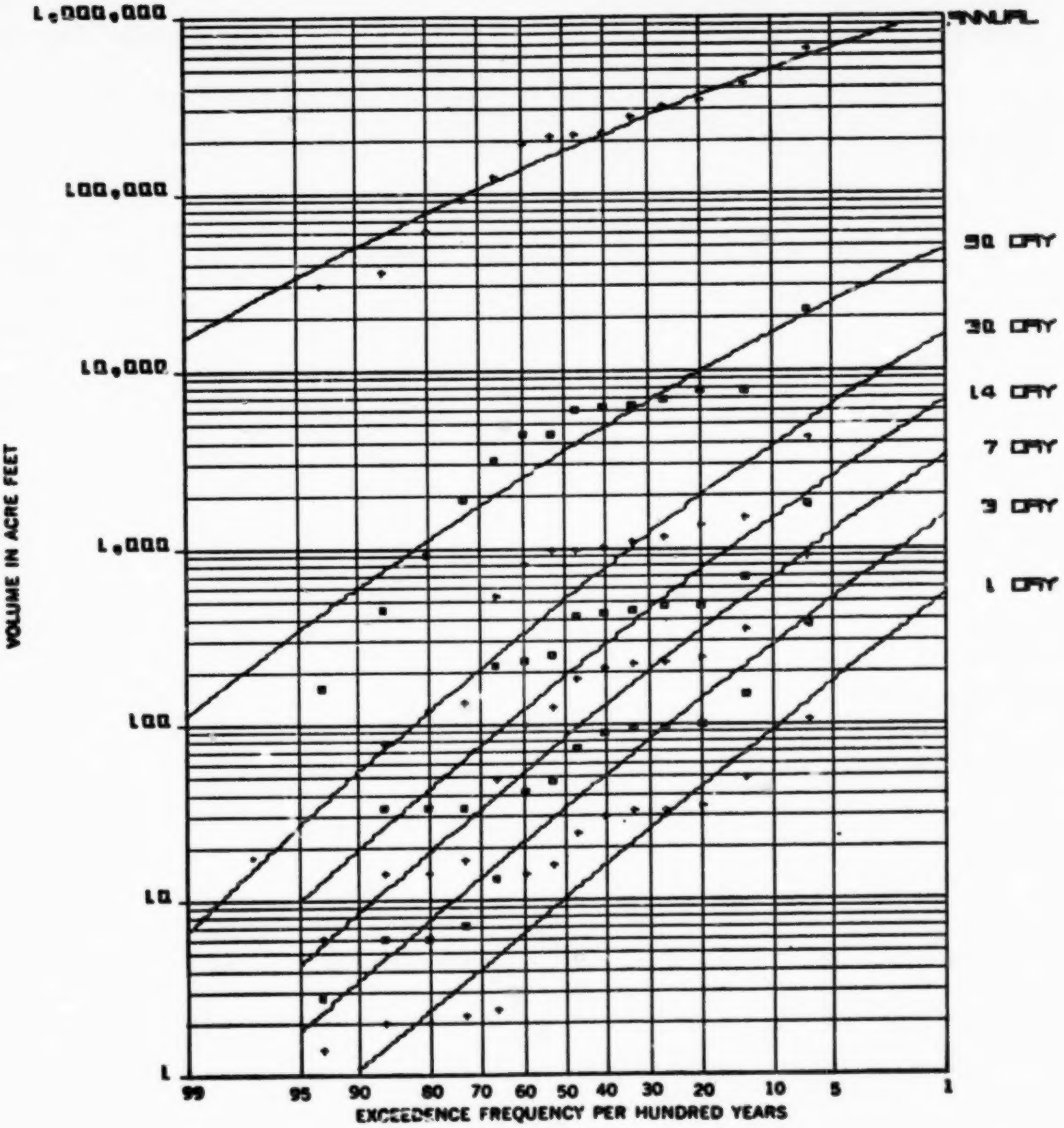
N = Number of Years of Record

M = Order of Magnitude (rank) of event

For the stations and durations where zero flows were experienced during a significant number of the years of record, an arbitrary assignment of a mean flow value of 0.1 cfs was made.

Footnote: The frequency curves drawn through the plotted points were based on fitting the Pearson Type III function by use of moments of logarithms of the annual minimum flow values in accordance with the procedure developed by L. R. Beard, Hydrologic Engineering Center, Sacramento District, Corps of Engineers.

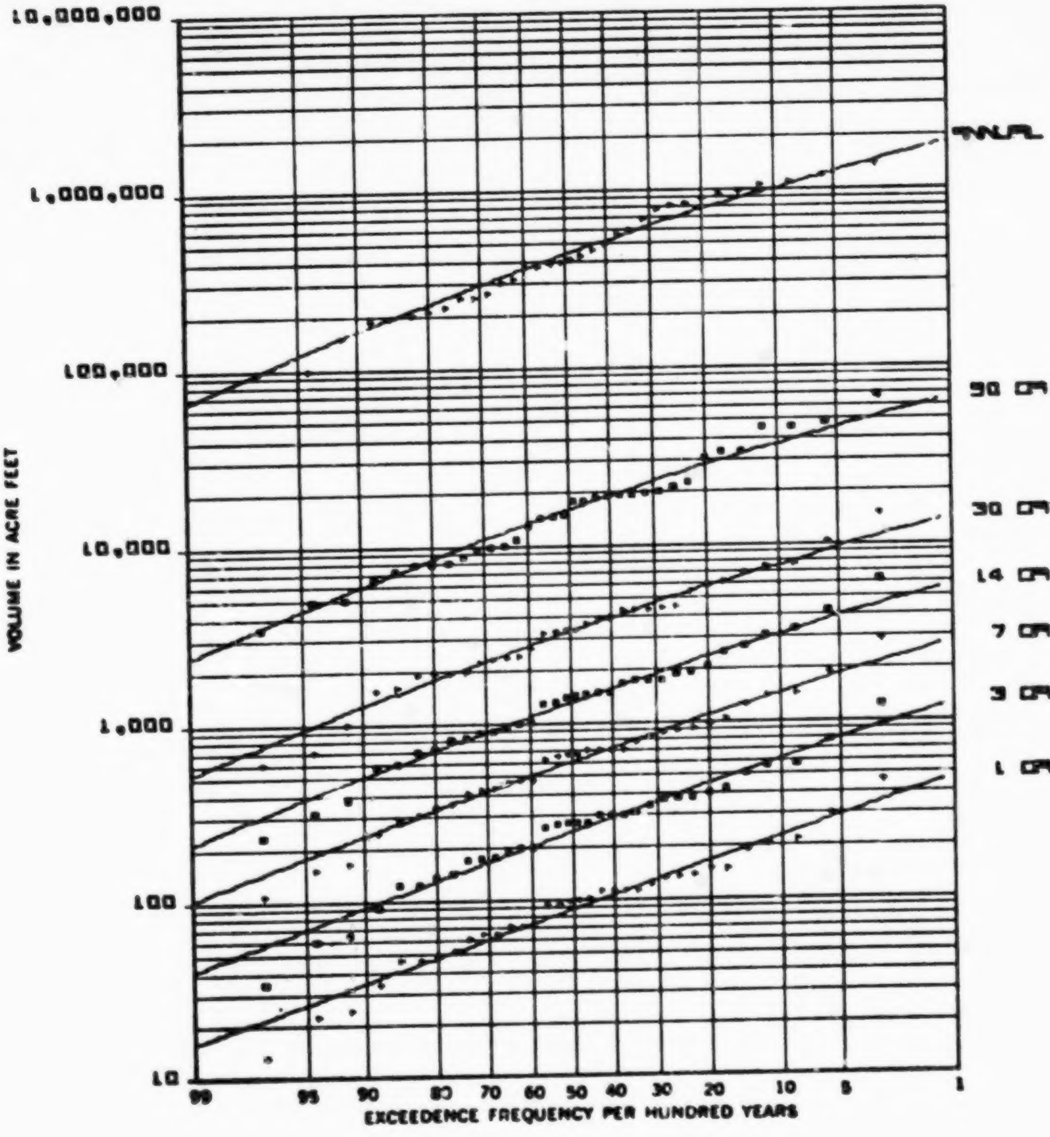
LOW-FLOW VOLUME-FREQUENCY DURATION CURVES



ROCK RIVER NR ROCK VALLY, IOWA

1945-1962 MIN 06-4835.00

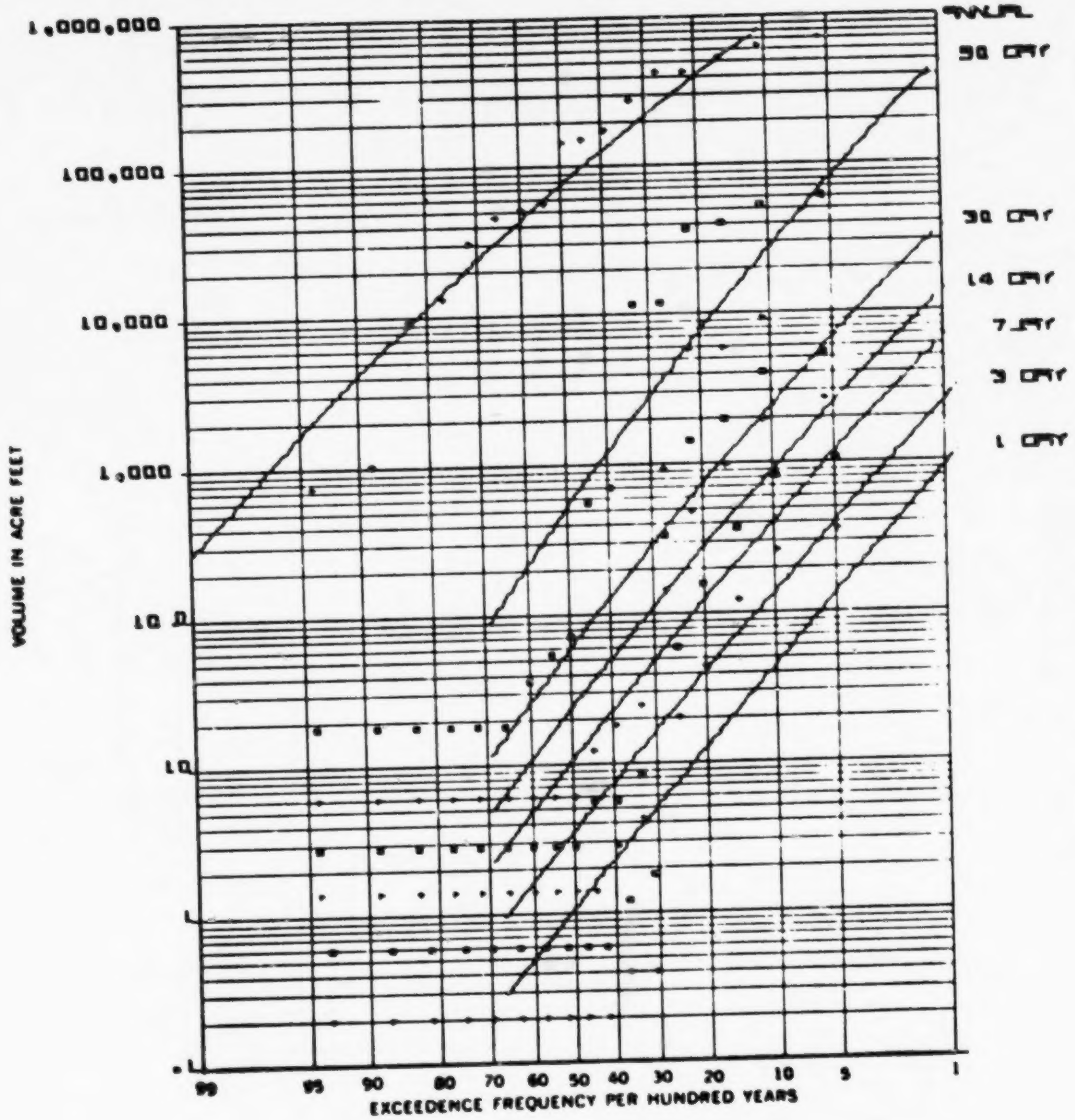
LOW-FLOW VOLUME-FREQUENCY DURATION CURVES



BIG SIOUX RIVER AT AKRON, IOWA

1929-1962 MIN 06-4855.00

LOW-FLOW VOLUME-FREQUENCY DURATION CURVES

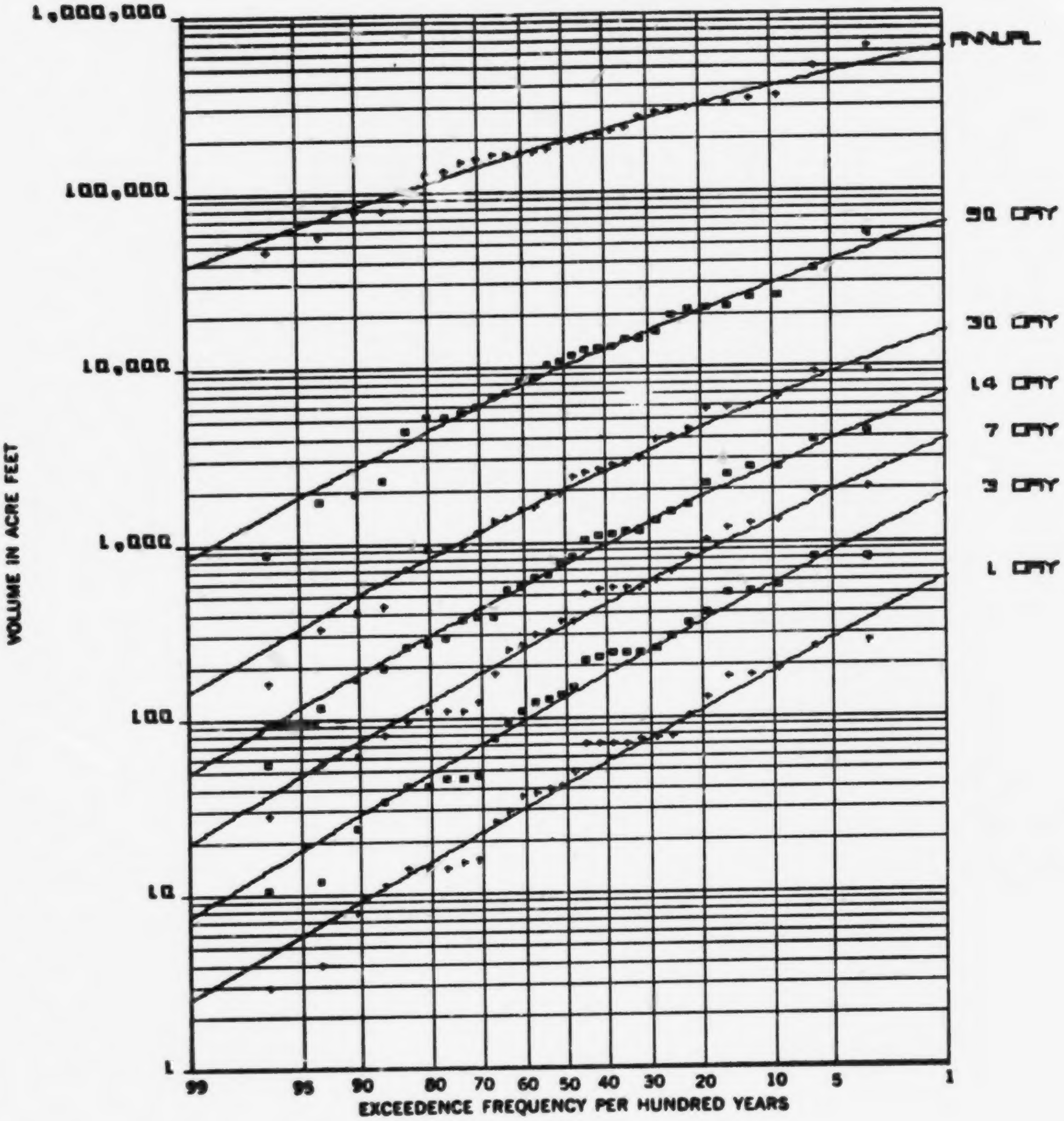


LITTLE SIOUX RIVER NR TURIN, IOWA

1940-1996 MIN 06-6074.55

C

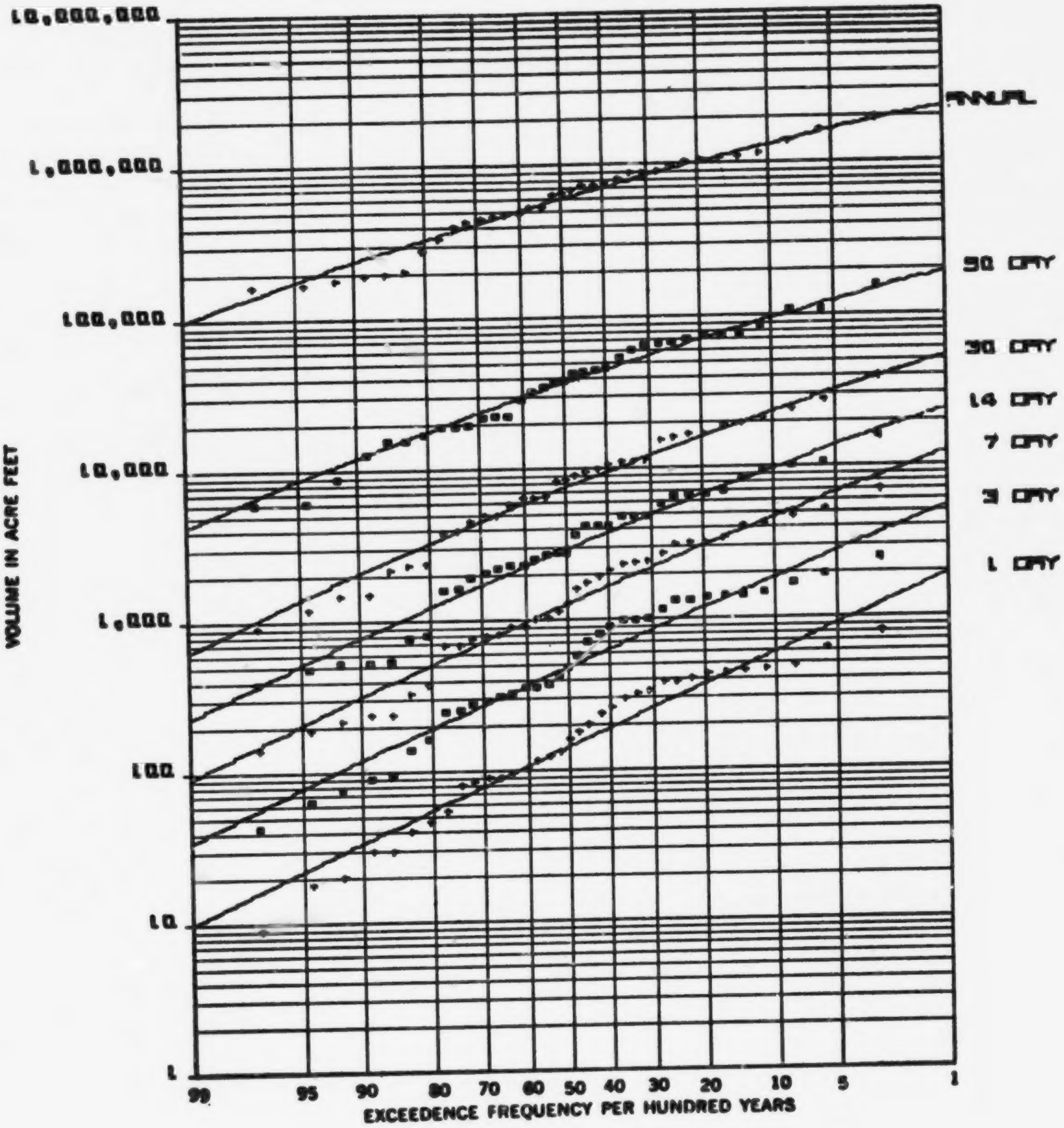
LOW-FLOW VOLUME-FREQUENCY DURATION CURVES



BOYER RIVER AT LOGAN, IOWA

1919-23,38-62 06-6095.00

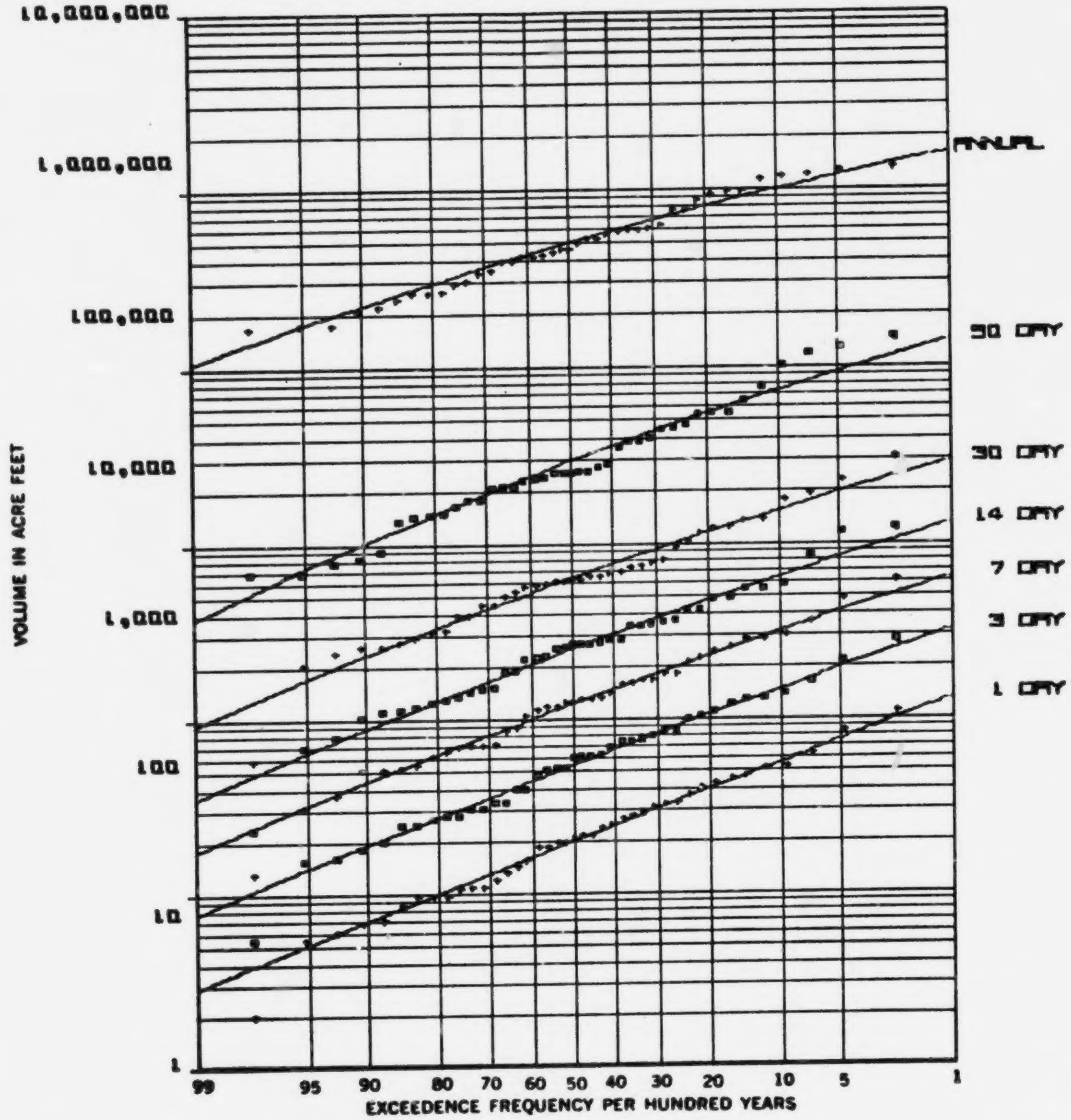
LOW-FLOW VOLUME-FREQUENCY DURATION CURVES



NISHNABOTNA RIVER ABOVE HAMBURG, IOWA

1922-29-62 MIN 06-8100.00

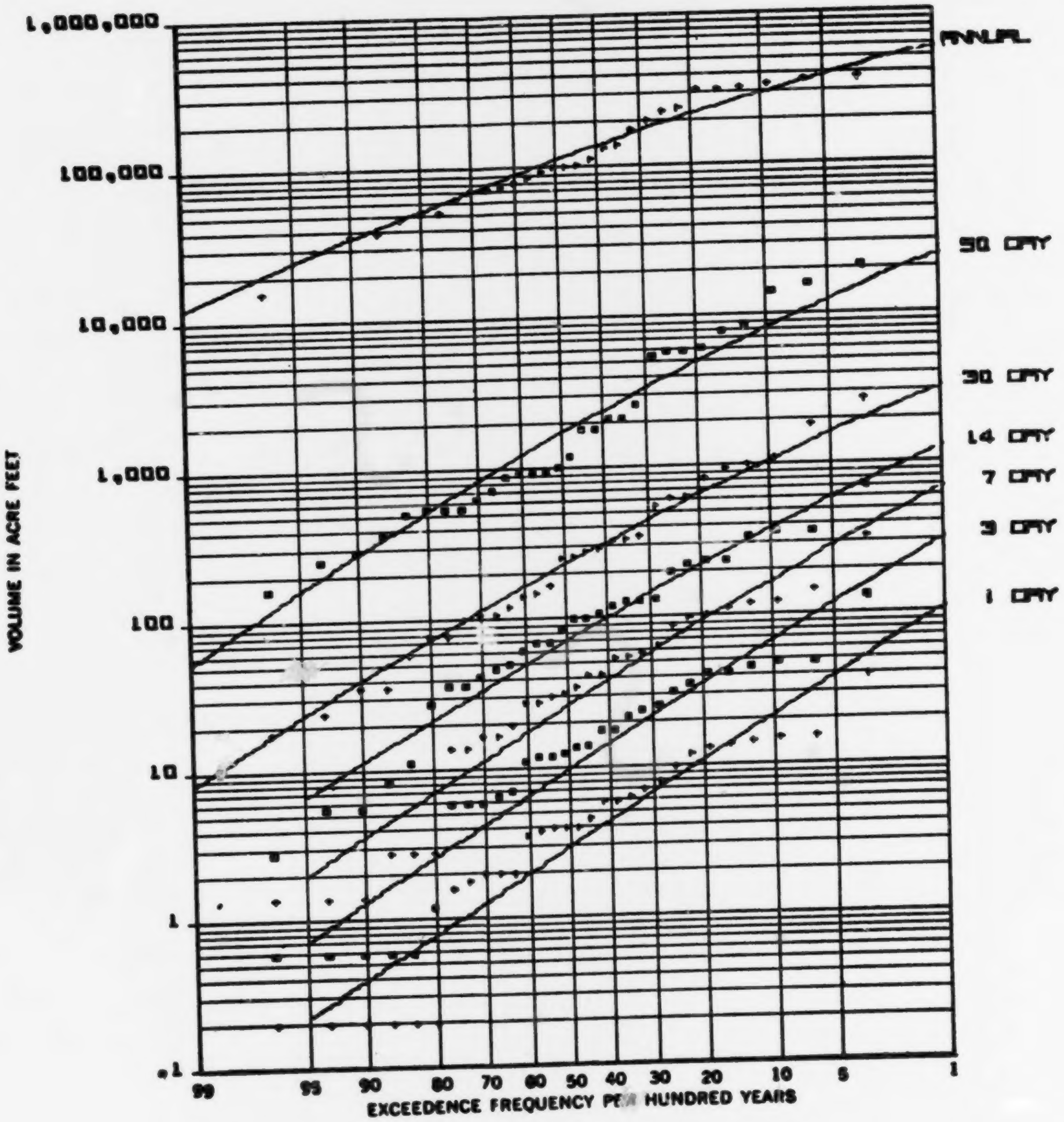
LOW-FLOW
VOLUME-FREQUENCY
DURATION CURVES



NODAWAY RIVER NR BURLINGTON JUNCTION, MO.

1922-1962 06-8175.00

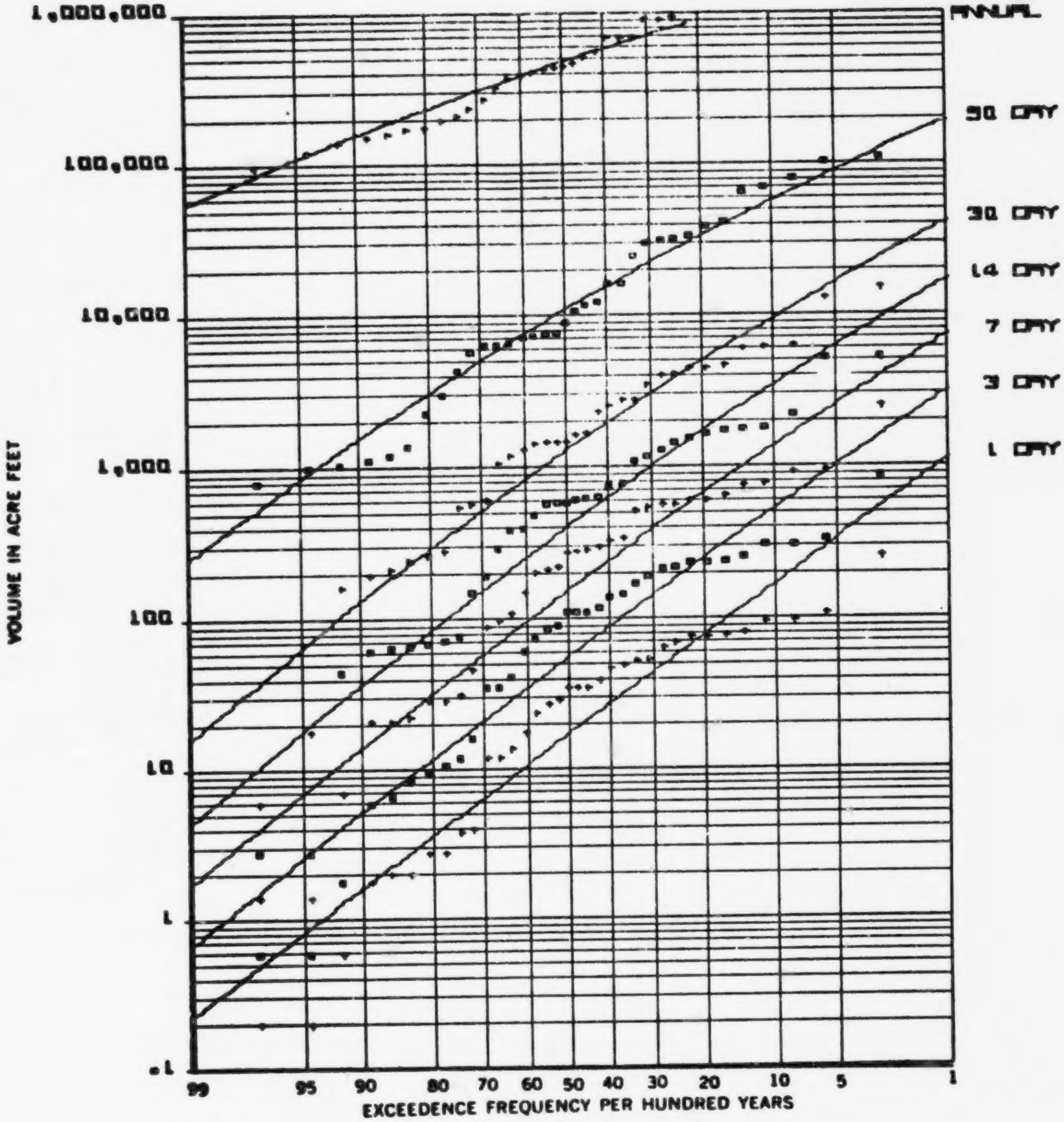
LOW-FLOW VOLUME-FREQUENCY DURATION CURVES



102 RIVER AT MARYVILLE, MO.

1933-1962 MIN 06-8195.00

LOW-FLOW VOLUME-FREQUENCY DURATION CURVES



PLATTE RIVER AT AGENCY, MO.

1925-29,33-62 06-8205.00

(H)

As an example, the curves for Station 8195, 102 River at Maryville, Missouri, (Curve G) show that the minimum values for the 7-day curve were 1.4 acre-feet for 3 of the 30 years of record. Although the graph shows 1.4 acre-feet, this value is equated to an actual base line value of zero cfs. The eye-fit curve should not be extended below about 3.7 acre-feet (roughly .3 cfs). The exceedence frequency per hundred years nearest this point is 90 percent. It is assumed that in future years the minimum 7-day low flow expected from 102 River at Maryville will be zero cfs 10 percent of the time.

(NOTE: All curves A through H shown are for the climatic year ending March 31.)

The discharge rates of the Missouri River itself are briefly summarized in Table III-C-4. Periods of record end in 1967 and date back for the indicated number of years. It is essential to understand that the flow of the Missouri is highly regulated on the main stem and, therefore, the overall discharge values are somewhat buffered.

TABLE III-C-4

	Main Stem Location	Period of Record (yrs.)	Average Discharge (cfs)	Minimum Daily Discharge (cfs)	Maximum Discharge (cfs)	Drainage Area Sq. Mi.
115	Sioux City, Iowa	70	31,680	2,500 Dec. 29, 1941	441,000 Apr. 14, 1952	314,600
134	Omaha, Nebraska	39	27,690	2,200 Jan. 6, 1937	396,000 Apr. 18, 1952	322,800
137	Nebraska City, Nebraska	38	33,470	1,600 Dec. 31, 1946	414,000 Apr. 19, 1952	414,400
147	Rulo, Nebraska	18	36,190	4,420 Jan. 13, 1957	358,000 April 22, 1952	418,905
	St. Jospeh, Missouri	38	36,830	2,300 Jan. 9, 1937	397,000 April 22, 23, 1952	424,300

IV. WATER USES, WASTE SOURCES AND WATER QUALITY

IV-A - WATER USES

1. INTRODUCTION

Section 1(a), Declaration of Policy, of the Federal Water Pollution Control Act (33 USC 966 et seq.) states "The purpose of this Act is to enhance the quality and value of our water resources and to establish a national policy for the prevention, control, and abatement of water pollution." The value of the nation's water resources for all beneficial uses are impaired to a degree proportional to the instances of poor quality caused by discharge of controllable wastes. Adherence to the Federal policy declared in the Act requires that all beneficial uses of the water be recognized. Quality enhancement requirements must be promulgated in such a manner as to protect those uses and increase the value of the resource.

In the area of the Missouri River Basin between Sioux City, Iowa, and St. Joseph, Missouri, information on beneficial uses were obtained from: 1) water quality standards documents; 2) a synoptic survey of the main stem and selected tributaries by Department of the Interior personnel; and 3) from reports prepared by other State and Federal agencies.

The following eight categories of use are documented for the streams in question and are recognized as deserving of protection from impairment by quality degradation.

1. Public water supplies
2. Recreation, including body contact water sports, fishing, boating and esthetic appreciation
3. Commercial fishing

4. Wildlife habitat
5. Industrial water supply
6. Navigation
7. Agriculture
8. Animal Watering

A summary of the number of use points by category on the main stem Missouri found during the synoptic survey is displayed in Table-IV-A-1. Table IV-A-2 contains a list of discrete use points.

Table IV-A-1

Summary of Existing Water Uses by Category, Missouri main stem between River Mile 449.5 (St. Joseph Bend) and River Mile 734.0 (Confluence of Big Sioux and Missouri River.)

	Use Category	Iowa	Missouri	Nebraska	Kansas	Total
1.	Public Water Users	1	1	1	0	3
2.	Recreational 1/	27	11	39	2	79
3.	Commercial Fishing	17	3	16	0	36
4.	Wildlife Habitat 2/	11	0	2	0	13
5.	Industrial Water Users 4/	[illegible]	1	3	0	6
6.	Navigation Installations	5	2	32	0	39
7.	Agricultural Withdrawals 3/	2	0	0	0	2
8.	Animal Watering Sites 3/	0	0	4	0	4
	TOTAL	65	18	97	2	202

1/ Public access sites only - does not include private access developments by individuals.

2/ Migratory waterfowl use the entire river reach during migration periods as rest areas and provide extensive hunting opportunity for local and out-of-state bird hunters.

3/ Total shown is expected to be less than actual use.

4/ Power generating plants.

TABLE-IV-A-2

EXISTING WATER USES OF THE MISSOURI RIVER KNOWN TO THE FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

(1) Public Water Supply (2) Industrial Water Supply (3) Recreation (4) Fishing (5) Wildlife Habitat
(6) Animal watering (7) Agriculture (8) Navigation (9) Waste Assimilation

LOCATION*	IOWA (east side of river)	NEBRASKA (west side of river)
732-734 Sioux City Bend	(Confluence of Big Sioux and Missouri Rivers) - 734 (3) Rivercade Flotilla (several boat clubs plus USCG Auxiliary) (9) Perry Creek inlet - 732.2 (4) Commercial fishing (9) Drainage - 731.8 (3)(4) City Park (Boating, waterskiing, picnic, etc) (8) Rock barge - 731.8 (8) Kay Dee Chemical (Ammonia plant) - 731.8 (9) Stockyards drainage	(9) So. Sioux City dump - 733 (9) Drainage - 732.8 (3) Thacker's Marina - 30 boats - 732.8 (3) So. Sioux Marina - 75 boats - 732.2 (3) City Park - boat ramp (4) Commercial fishing
726-732 Floyd Bend	(7) Intermittent irrigation	(7) Intermittent irrigation (3) Rich's Marina-20 boats-726.5 (Mike Rich, Sioux City) (9) Iowa Beef Packers effluent (9) Dakota City (pop. 600) effluent
722-726 Dakota Bend	(9) AFB primary plant outfall (9) Terra Chemical Plant (Ammonia)	(4) Commercial fishing (James and Robt. Satterwaite)
719-722 Omadi Bend		(3)(4) Omadi State Park
716-719 Browers Bend	(2) Iowa Power and Light Co.-75 MGD Cooling Water-718.3 (8) Borden's Chemical (Ammonia Storage)	
714-716 Snyder Bend	(Planned Snyder-Winnebago Recreational Complex-700 to 716)	
711-714 Glover's Point Bend		
706-711	(9) Sloan (pop 600) secondary plant outfall	
702.5-706 Omaha Mission Bends		(3)(4) Sandstone Bayou Recreation Area - Boating (6) Cattle access area
698-702.5 Monona Bend	(9) Township dump (3) Lighthouse Mar'na - 20 boats	(3)(4) Big Elk Park
693-698 Blackbird Bend	(Planned Blackbird Bend Recreation Area) (3) Ivy Island Area	
691-693 Tieville Bend	(4)(5) Onawa Material Yards - County Conservation Area	(3) Decatur Marina-cabins-50 boats (Earl Hightree)
686-691 Decatur Bends	(3) Marina-Tekamah Boat Club - 20 boats (Robt. Aronson) (3)(4)(5) County Conservation Area	(8) Tobin's Island (C of E terminal)
681.5-686 Louisville Bends	(5) Louisville Bend State Refuge (3)(4)(5) County Conservation Area (9) Kleghorn ditch (from Onawa and Whiting)	
676.5-681.5 Blencoe Bends		(3)(4) Masonic Area
670-676.5 Little Sioux Reach	(4)(5) Deer Island Recreation Area	(6) Cattle feeders-(John Schneider and Wm. Lydick) (3)(4) Lydick's Lake
666-670 Little Sioux Bend	(4)(5) Three Rivers Recreation Area (4)(5) Little Sioux Delta Recreation Area (3) Marina - 5 boats (Elwood Peterson) (7) Intermittent irrigation	
663-666 Bullard Bend	(4) Commercial (Chas. Hilton) (3) Marina - 10 boats - cabins (Ivy Lane)	(3) Bullard Bend Hunting Area
661-663 Soldier Bend	(3) Soldier Bend Recreation Area	
657.5-661 Peterson Cut-Off		
655-657.5 Sandy Point Bend		
651-655 Tysons Bend	(3) Tyson Bend Recreation Area	(3) Cottonwood Marina-50 boats - 20 cabins (Duane Spanton)
649-651 California Cut-Off	(3)(4)(5) California State Recreation Area and Refuge	
648-649 Blair	(3) Rand Access (Recreation Area under development) (4)(5) Rand Bar Recreation Area	(8) Gulf Chemical (Ammonia Storage) (8) National Alfalfa Dehydrating and Milling Co. (3) Public boat ramp (3)(8) Kelly Ryan-Farm Equipment manufacture (8) Alfalfa Milling Co. (8) Chemical Storage (Ammonia)
644-648 DeSoto Bend	(3)(4)(5) National Wildlife Refuge (Kermit Dybsetter, Mgr.)	(4) Commercial (Pat Mallett and James Ryan, Blair)
642-644 DeSoto Cut-Off	(3)(4) Wilson Island Recreation Area	(3) Waterfowl hunting area (Nuclear Power Plant under construction-Omaha Public Power District)
637-642 Calhoun Bends	(3) Boat ramp (3) Boat dock	(8) Limestone guarry docks
634-637 Boyer Bend		
631-634 Rockport Bends	(3) Goose Haven Cabins	(3) Boat dock (3) Marina-30 boats-Surfside North (Robt. Vondrasek)
626.5-631 Pigeon Creek Bends		(3) Boat dock (3) Recreation Area (under development) (8) Gov't Maintenance Base (C of E) (3) Boat ramp - (Dodge Park under development-picnic area, cabins)
623.5-626.5 Florence Bend		(1) Omaha M.U.D.-capacity-140 MGD; use thru 1968- 65 MGD; current use- 40 MGD; after 1982- 70 MGD; (Robt. Bell, Director; Richard Hawes, Mgr of Water Supply) (2) Omaha Public Power Dist. - cooling use-210 MGD (Ted Hartung, Director)

* Location is referenced to channel mileage as indicated in Corps of Engineers publications:
1) Omaha District "Missouri River-Ponca to Rulo, Nebr." - 30 June 1968
2) Kansas City District "Part 1, River and Harbor Projects" - 30 June 1968

TABLE-IV-A-2 (Cont'd)

EXISTING WATER USES OF THE MISSOURI RIVER KNOWN TO THE FEDERAL WATER POLLUTION CONTROL ADMINISTRATION--Continued

LOCATION*	IOWA (east side of river)	NEBRASKA (west side of river)
623.5-626.5 Florence Bend--Continued		(8) West Central Co-op Grain Co. Terminal (8) Pentzien, Inc. Boatways (8) Mo. Portland Cement Co. Terminal (8) Cargo Carriers Terminal
618-623.5 The Narrows	(Car body smelter under construction) (1) City of Co. Bluffs Water Intake; capacity-11 MGD; current use-7 MGD; after 1982- MGD; Barney Rew, Mgr.	(6) Cattle feed lot
615-618 Council Bend		(3) River Club Marina-50 boats (8) Aaron Ferer Scrap Metal (8) Archer-Daniels Midland Co. Terminal (8) Sioux City and New Orleans Terminals (8) Cargill, Inc. Terminal (8) Municipal Dock (9) Omaha Packing Co. (2600 P.E.)
	(9) Outfall from City primary plant (39,000 P.E.)	(9) Outfall from City Primary plant (750,000 P.E.) (8) Cargill, Inc. Terminal
	(3) Boat Dock	
612-615 Omaha Bend		(9) Outfalls from Packing Houses and Stockyards (3) Boat Landing (4) Commercial (Emil Dusek, Omaha)
	(8) Peavey Co. of Omaha Terminal (9) Rendering Plant (600 P.E.)	(9) Quaker Oats Furfural (250,000 P.E.)
		(8) Mo. Valley Inc. Terminal
607.5-612 Gibson Bend	(3) Boat Ramp	(3)(5) Fontenelle Forest (nature park-refuge) (James Malkowski, Mgr.)
605-607.5 Manawa Bend	(3)(4) Pottawattamie County Conservation Area (State Rec. Area under development) (2) Iowa Power and Light Plant-cooling; 68 MGD; (John Thorson, Mgr.)	
601-605 Bellvue Bend		(3) Boat Dock (9) Outfall from Bellvue primary plant (3200 P.E.) (2) Nebr. Public Power Dist.; Usage-25 MGD (R. J. Rhodes, Mgr.) (3) Boat ramps - City Recreation Area
598-601 Bellvue Reaches		(3) Offutt Lake Intake - Boating for AFB (4) Sport
596-598 St. Marys Cut-Off		(8)(9) Allied Chemical Plant (3) Boating-developed area (4) Commercial Fishing (Melvin Barr, Plattsmouth)
594-596 Papillion Bend		(Confluence of Platte and Missouri Rivers) - 594 to 595 (5) State Wildlife Management Area (Gary Browne, Mgr.)
589-594 Plattsmouth Bends		(3)(4)(8) Municipal Dock - Boat Ramp Plattsmouth Boat Club-30 boats (9) Outfall from Plattsmouth primary plant (3800 P.E.)
	(3)(4) Boat Landing	
585-589 Tobacco Bend		
583-585 Bluff Bend		(8) Equity Union Grain Co. Terminal
582-583 Calumet		
579-582 Bartlett Bend	(3) Boat ramp	
576-579 Pin Hook Bend		
574-576 Van Horns Bend		(8) Rock Dock - Quarry
570-574 Civil Bends	(3) Boat Dock	
563-570 Copeland Bends		(3)(4) Boat Ramp Riverview State Rec. Area
560-563 Nebraska Bend	(5) State Wildlife refuge	(8) Steinhart Terminal (City wells near River-Vern Livingston)(873-3353) (3)(4) Boat Ramp (8) Mid States Grain Terminal (3) Bartlett Grain Co. Terminal (8) Steinhard Terminal-Municipal Dock (9) Outfall from Nebr City primary plant (12,000 P.E.)
	(3)(4) Boat ramp - Waubonsie River Access	(8) Nebr City Dock and Grain Terminal
557-560 Fraziers Bend		
555.5-557 Otoe Bend		(3) Boat Ramps
551-555.5 Hamburg Bends	(3)(4)(8) Hamburg Boat Landing MISSOURI (east side of river)-552.6	
547-551 Barney Bends		(3) Boat Ramp
543.5-547 Kansas Bends		(3) Boat Ramp
542-543.5 Nishnabotna Bend	(Confluence of Nishnabotna and Missouri Rivers)-542	(3) Boat Landing (4) Commercial (Ramon "Dutch" Henry, Peru)
540-542 Peru Bend		(9) Peru Secondary Plant (250 P.E.)
535-540 Sonora Bends	(3) Boat Landing	(8) Continental Grain Co. Terminal (8) Brownville Grain Co. Terminal (Mr. Holland) (3) Boat Ramp
532-535 Brownville Bends		

TABLE IV-[illegible]

EXISTING WATER USES OF THE MISSOURI RIVER KNOWN TO THE FEDERAL WATER POLLUTION CONTROL ADMINISTRATION--Continued

LOCATION*	MISSOURI (east side of river)	NEBRASKA (west side of river)
529-532 Langdon Bend	(3) Langdon Bend Conservation Area (under development)	(3) (Indian Cave State Park under development) (Skiing, Picnicing, Camping, Cabins, Fishing, Boating, etc.)
526-529 Aspinwall Bend		
522-526 Morgan Bends	(3) Boat Landing - Hoot Owl Bend access	
520-522 Lincoln Bend		
517-520 Deroin Bends		(3) Boat Dock
516-517 Cave Bend	(3) Boat Dock	(2) Consumers Public Power District has a nuclear plant under construction (Denny Cochrane, Mgr.)
511-516 Hemmies Bend	(3) Boat Landing	
506.5-511 Cottier Bends	(3)(4) Thurnaw State Wildlife Area	(3) Boat Landing, Beaver trapping (6) Cattle feeding (Vincel Moorhead, Barada)
502-506.5 Arago Bends		
499-502 Rush Bottom Bends		
494-499 Rulo Bend		(3)(4) Rulo Boat Club - Water skiing (Confluence of Big Nemaha and Missouri Rivers)-495 (8) Wharf at Rulo
491-494 Nemaha Bend		
489-491 Squaw Bend		
		KANSAS (west of river)-489.8
486-489 White Cloud Bends	(4) Commercial Fishing (Eugene Flint, Forest City, Mo.)	(3) White Cloud Landing
483-486 Iowa Point Bends	(3) Boat ramp (4) Commercial Fishing (Wayne Hill, Oregon, Mo.)	(3) Cedar Creek Landing
459-463 Hill Creek Bend	(3) Recreational Area access	
455-459 Burr Oak Bend		
452-455 Amazonia Bend	(1) St. Joseph Water Co. intake. Capacity-21 MGD. Current usage-15 MGD (Wm. Prickett, Mgr.)-452.4	
449.5-452 Bon Ton Bend	(9) Outfall from City primary plant (95,000 P.E.) (3) Marina - 10 boats - (privately owned)	
442.5-449.5 St. Joseph Bend	(8) USCG Base (9) Packing Companies (275,680 P.E.) (8) Dannen Mills, Inc. Wharf (3) Boat ramp (McBrides) (3) St. Joseph Yacht Club (2) St. Joseph Light and Power 33 MGD Cooling	

2. PUBLIC WATER SUPPLIES

Withdrawals for public water supply needs represent the water use among the highest protection level requirements and value in the area being considered. The cities of Council Bluffs, Iowa; Omaha, Nebraska and St. Joseph, Missouri use the Missouri River as a source of supply. These three withdrawals combined are approximately 62 million gallons of water per day.

Withdrawal and use of water for public consumption, which is contaminated by inadequately treated wastes, is not consistent with accepted practices for the protection of public health and welfare.

3. OUTDOOR RECREATION

In an attempt to identify and analyze the recreational assets and uses of western Iowa and the Missouri River, many pertinent recreation reports, studies, and plans were reviewed. Based on this review, Appendix C was prepared which is entitled Outdoor Recreation and Water Pollution in Western Iowa and Along the Missouri River. This appendix should be referred to as it contains detailed and descriptive information on the recreation resources of this area.

The numerous documents reviewed were prepared by various governmental agencies and represent the findings and recommendations of exhaustive efforts. All appear to be unanimous in their conclusions of the Missouri River that recreation is an existing use; that there is a latent and growing demand for additional resources and facilities; and that the area is capable of meeting the unsatisfied needs and demands. Furthermore, the Missouri River and its immediate environment can provide recreational opportunities beyond those required by the resident population.

Present recreation use along the Missouri River in Iowa has not met its potential for the amount of land and water acreage involved. While being light, however, it appears that most recreation activities are participated in with sightseeing, boating, picnicking, and fishing as the most popular. There are over 30 known developed recreation areas along the Missouri River in Iowa. Included among this list are boat clubs, marinas, city parks, conservation areas, refuges, recreation areas, boat ramps, commercial cabins, boat docks, and boat landing sites. There are even a greater number of recreation areas on the Nebraska side of the river. These generally include the same type of areas as in Iowa; however, the list is expanded to include State parks, wildlife management area, nature park, waterfowl hunting areas, and a river club.

While this relates a direct use of the river at developed recreation sites, there is undoubtedly a considerable amount of use that occurs in the natural undeveloped reaches for such activities as hunting, hiking, camping,nuture study, fishing, etc. Also, there is undoubtedly a significant amount of use resulting from persons driving roads and trails in quest of pleasure drives and sightseeing.

Water skiing surprisingly is enjoyed even though the river contains a high silt load. Swimming is not considered a common activity due in large measure to the dangerous water conditions and high turbidity. In the Sioux City area there is an annual canoe race on the river which is well attended. Fish species in this stretch of the Missouri include catfish, drum, crappie, black bass, white bass, walleye, sauger and paddlefish.

The Corps of Engineers estimate that 250,000 visitor-days are presently initiated at limited access points between Sioux City and Rulo, Nebraska, which includes the stretch of the Missouri River in Iowa. For comparative purposes, another projection might be useful--that of fisherman-days on the 80-mile stretch of the Missouri between Sioux City and Yankton, South Dakota. The BSF&W estimates that 32,000 fisherman-days occur annually. This stretch of the river below the Gavins Point Dam, is immediately upstream from the Iowa border. It is not affected by multi-source waste discharges.

Figures compiled from data in Iowa's outdoor recreation plan indicate that some 52 million days of recreation use, by residents 12 years and older, occurred in the western region of Iowa in 1965. Driving for pleasure, picnicking, sightseeing, and walking for pleasure were the most popular activities sought. Although an exact measurement of present use is unavailable, it can readily be seen that the Missouri River is used for recreation purposes.

Perhaps the best way to depict the recreation potential of the Missouri River is to outline the more significant actions proposed, and express some of the pertinent extracts from the reference material. Foremost, is the establishment of the Lewis and Clark Trail along the full route of the Missouri River. Since Congress established the Lewis and Clark Trail Commission in 1964, the Missouri River has been recognized as a national resource worthy of development to a far greater degree than heretofore. The purpose of this act was to create an appreciation of the resources, encourage their conservation, and to promote the protection and development of outdoor recreation resources along the route for public use and enjoyment. The development plan prepared by the Bureau of Outdoor Recreation provides for many and varied resources linked along the entire route to satisfy the full spectrum of recreation activities from the most active to the most passive. Some 35 recreation sites were identified for construction by the Corps of Engineers between Sioux City and Rulo, Nebraska.

The National Commission, in association with all of the affected States including the Iowa State Lewis and Clark Trail Committee, is now implementing those actions necessary to achieve the national objectives. To date, one of the principal tasks has been accomplished--that is, the marking and historical interpretation of the route on the roads which parallel, adjoin, and otherwise provide access to the river. Among the problems mentioned as confronting full attainment of the recognized goals is water pollution. The Commission specifically recommended that the FWPCA give continuing attention to the abatement and control of water pollution and that States also take steps to strengthen measures to reduce water pollution along the Trail route.

The Bureau of Outdoor Recreation's preliminary report on the Middle Missouri Tributaries Subregion (part of the MBIAC Framework Study) indicated that increased future recreation demands would result as "greater interest in the Missouri River as a play area, as pollution and siltation control result in clearer and cleaner waters and greater interest in and use of the Missouri River as the Lewis and Clark Trail plans are completed." Further, "That the most pressing current needs are for development of planned boat access points on and access to the river and improvement and development of the Missouri River Oxbow Lakes." Finally, "The most important and widely mentioned Type I potential is the promotion and development of recreation sites, roads, trails, signs, interpretive facilities, and other improvements in connection with the Lewis and Clark Trail."

In the MBIAC May 1968 Missouri River main stem study, it was estimated that recreation demand would be 10,520,000 activity-days by 1980 exclusive of fishing and hunting. This generally involves the main stem from Yankton, South Dakota, to St. Joseph, Missouri, and includes the Missouri through Iowa. Sightseeing accounted for 40 percent of the estimated use. Of significance in this report is that 33 percent of the water oriented needs could be met by the main stem of the Missouri in 1980. Based on data in Iowa's outdoor recreation plan, recreation use by residents 12 years or older, is expected to be over 54 million days in 1980, in the western counties.

Speaking at a 1964 MBIAC meeting, the Planning Director of the Iowa State Conservation Commission discussed Iowa's long range recreation plans. Of importance is this statement, "The Missouri, on our western boundary, probably has the greatest potential for recreational development of any one area that we could mention. With flood control a reality, a stable river channel, navigation and other factors of progress, we suspect a major buildup of people along the Missouri."

The Bureau of Sport Fisheries and Wildlife has projected capacity figures for fisherman use along the 161-mile stretch of the Missouri

River in Iowa. The 71 miles from Sioux City through Burt County, they estimate the capacity is 125 fisherman-days per mile per year. In the lower 90 miles, it is reduced to 25 fisherman-days per mile per year. Thus, the river's total capacity is 11,125 fisherman-days per year. This is for the entire river and would be halved if Iowa's portion would be separated. It should be pointed out that these figures represent capacity, not actual use.

As in the case of existing recreation use, potential use defies exact measurement for the Missouri River in Iowa. However, it has been plainly demonstrated that the Missouri River, and its immediate enviornment, offer tremendous opportunity for public use and enjoyment to both the local resident and the nation as a whole. The future use will expand commensurate with access and facilities. It can be expected that use on the waters of the Missouri will principally be in the form of fishing and boating, and on the adjoining lands in the form of sightseeing, picnicking, hiking, driving and walking for pleasure, and in historical interpretation.

4. COMMERCIAL FISHING

Thirty-six separate commerical fishing use points were identified in the conference area. Of this total, 17 were located in the State of Iowa and the remaining 19 in the States of Nebraska and Missouri. The true intensity of commercial fishing demand is probably not reflected by these figures, since the use points were identified by interview and not check of the numbers of commercial fishing permits issued by conservation agencies.

5. WILDLIFE HABITAT

The conference area is in one of the major migratory bird flyways. Consequently, many of the marsh and wetland areas serve as nesting or temporary resting sites for waterfowl in their annual migrations. Thirteen conservation or waterfowl hunting locations were located by survey along the Missouri River stressing the importance of the area in maintaining suitable waterfowl populations in the flyway. With increasing interest and enthusiasm by the sporting and conservation groups, it is expected that many additional areas will be reserved in the future for the support of wildlife.

6. INDUSTRIAL WATER SUPPLY

Discrete industrial water supply users identified by the synoptic survey numbered six. Of this total, two were located in Iowa and the remaining four in Missouri and Nebraska. Future economic development of the major metropolitan areas will undoubtedly be based on industrial growth and an increase in the industrial water use can be expected. Unidentified are the numerous industries obtaining their water supply from municipalities.

7. NAVIGATION

Navigation is an important use of the Missouri River. The Federal Government has invested millions of dollars in structures to maintain and improve a navigable channel in the river. Each year efforts are made, weather depending, to extend the navigation season. The brief survey identified a total of 39 navigation installations to assist in loading materials on and off the river barges. A premise for future development of the conference area certainly must be more extensive use of waterborne commerce.

8. AGRICULTURAL WITHDRAWALS

Only two distinct agricultural withdrawal points were located by the Department of the Interior survey. More intensive farming practices on the flood protected plains bordering the river would certainly increase the quantity of water for agricultural usage through supplemental irrigation.

9. ANIMAL WATERING

The animal watering usage on the main stem was found entirely in the State of Nebraska.

10. GENERAL

At the present time, the primary uses of the Missouri River are domestic water supply, navigation, recreation and commercial fishing. Other use categories identified are in the infancy of growth. Future development of the area will see a more intensive water use in each category.

IV-B - EXISTING WASTE SOURCES

1. MUNICIPAL WASTE SOURCES

A tabulation of municipal waste treatment systems discharging into the main stem of the Missouri River between Gavins Point Dam and the Iowa-Missouri State line and all municipal waste treatment systems in the State of Iowa discharging to tributaries of the Missouri River is included on pages IV-24 and IV-30.

Most treatment facilities constructed or enlarged since 1956 have utilized Federal construction grants. These treatment facilities were constructed at a total cost of $40,283,174 including Federal grants amounting to $6,170,645.

All towns and cities located on the main stem section of the Missouri River, with the exception of Omaha, have at least primary waste treatment facilities in operation at the present time. The existing treatment facilities for the city of Omaha will eventually receive all wastes from land areas draining directly to the Missouri River, but at the present time are only capable of treating approximately 50 percent of the wastes. Omaha has under construction facilities which will pretreat industrial wastes. When these are completed, all wastes will receive primary treatment.

Of the 14 municipalities along the Missouri River between Yankton and Rulo, nine provide only primary treatment and the other five provide secondary. On Missouri River Basin interstate streams in Iowa there are 28 cities with sewage systems. Eighteen provide secondary, eight only primary, two discharge to adjoining municipalities, and two provide no treatment of their wastes. Of the 118 municipal discharges to intrastate waters, 94 receive secondary treatment, 15 primary and 9 have no treatment.

Total Number of Treatment Facilities	
Secondary	117
Primary	32
None	11
TOTAL	160

Wastes discharged to these 160 municipal sewerage systems have a total estimated population equivalent of 3,500,000. Secondary treatment is provided for only about 48 percent of this connected load. Fifty-one percent of the waste loading is discharged to 31 plants which provide primary treatment. Less than one percent of the wastes is discharged without treatment.

2. INDUSTRIAL AND OTHER SEPARATE WASTE SOURCES

There are two hospital installations, one chemical plant and a rendering company and eight packing plants of varying sizes in western Iowa with separate waste systems. Their combined waste loadings before treatment are estimated to equal 342,000 population equivalents (P.E.). The rendering company at Alton, Iowa, is discharging raw wastes to a stream. The remaining nine plants (1 chemical and eight packing) operate their own treatment facilities which provide an estimated BOD removal of over 85 percent. Seven large meat packing companies in this group account for about 337,000 P.E.'s. Significant industrial or other waste disposal systems are listed in Table IV-B-1. The estimated flow from these seven plants is about six million gallons per day.

TABLE IV-B-1

Major Industrial and Other Separate Waste Systems
Missouri Basin - Iowa

City		Reported Design Data		Reported Efficiency
		P.E.(BOD)	Flow (gpd)	
Harlan	Western Iowa Pork	24,250	390,000	95%
Oakland	American Beef Packers	21,600	720,000	95+%
Oakland	Oakland Beef Feeders	-	-	(1)
Glenwood	Swift & Company	38,650	1,000,000	(2)
Denison	Iowa Beef	76,800	960,000	98.5%
Denison	Farmbest	64,500	850,000	85%(3)
Cherokee	Wilson & Company	84,600	1,300,000	98+%
LeMars	Blue Ribbon Beef	26,450	800,000	(1)
Alton	Rendering Co. (No Trmt.)	200	-	0
Sioux City	Terra Chemical Co.	-	700,000	(4)
Glenwood	State Hospital	3,070	432,000	85%
Cherokee	Mental Health Institute	1,500	200,000	85%

(1) No surface effluent

(2) Packing plant and treatment facility under construction. (Estimated completion April 1969.)

(3) Surfpac filter unit under construction.

(4) Ammonia waste - 1.5 day of flow equalization in ponds.

The Iowa Directory of Industries lists in the Missouri Basin in Iowa the following number of industries by selected classification:

Food and Kindred Products	121
Chemical and Allied Products	29
Petroleum Products	3
Rubber and Plastics	10
Primary Metals	3
Electro Plating	1
TOTAL	167

Many of these industries discharge their wastes to municipal sewerage systems.

The number of industrial waste sources relating to meat processing is a reflection of the extent of agricultural activity in the conference area.

3. FEDERAL INSTALLATIONS

There are five significant Federal installations on or near the Missouri River bordering the State of Iowa.

The Corps of Engineers' dock and service base at Omaha is served by a septic tank and subsurface soil absorption system. The DeSoto National Wildlife Refuge has a number of waste treatment systems. The headquarters and major recreational areas are served by seven septic tanks and subsurface soil absorption systems. All of these are of adequate size and are functioning satisfactorily. Some of the low use areas in the refuge are served by pit or vault toilets. All of the pit toilets are scheduled for replacement by more adequate facilities.

The Offutt Air Force Base has a complete sewage system. The wastes have a volume of 1.1 mgd with an estimated P.E. strength of 14,700. The treatment facilities provide an 88 percent removal of BOD. The effluent has an estimated P.E. of 1,800 and discharges to Papillion Creek about 2½ miles above the confluence with the Missouri River.

The Omaha Air Force station has been deactivated; however, a portion of this station will be operated by the Federal Aviation Administration. The existing septic tank-lagoon is adequate for the loading. The effluent is discharged to a small watercourse several miles from its confluence with the Missouri River.

The Sioux City Air Base operated as a tenant of the Sioux City Municipal airport until 1 July 68 when the base was deactivated. The City of Sioux City continues to provide sewage service for some housing that remains in use. A lagoon provides treatment for the wastes. This flow will be intercepted and the lagoon abandoned upon completion of an interceptor sewer now under construction. Some wastes from the airport and Sergeant Bluff also discharge to the lagoon.

Winnebago Indian Agency has a complete sewerage system. The wastes are estimated to have a volume of 600 gpd with an estimated strength of 100 P.E.'s. Treatment provides a 90 percent removal of BOD. The lagoon which provides the treatment had no overflow as of May 1968 and at the time of this inspection, the water level was from 1 to 2 feet below the overflow level.

4. WATERCRAFT POLLUTION SOURCES

a. Recreation Craft

There are no available compiled records of recreational boating on the main stem of the Missouri in the area. There are reports that a number of houseboats are seasonally anchored below Gavins Point Dam on the main stem of the Missouri River. Houseboats and floating dormitories are usually anchored during the warmer season in sheltered coves.

There are a number of marinas for the launching and servicing of recreational craft and the indications are that the recreational use of this stretch of the Missouri River will increase. As of December 1968, approximately 70,000 boats are registered by the Iowa Conservation Commission and 10,250 by the Nebraska Game and Parks Commission. A question regarding available onboard toilet facilities is included in the Iowa registration form. It is estimated less than one percent of the registered boats have toilet facilities.

Meetings have been held by the Conservation and Health Departments of Iowa, Nebraska and South Dakota for the purpose of discussing uniform watercraft regulations to avoid difficulties that would result from non-uniform requirements. Regulations requiring holding tanks for storage of water from marine toilets will be considered by States as a positive means of control. An agreement has been reached among the State agencies and the Corps of Engineers requiring "pump out" facilities in the newly developed marinas to accommodate boats with holding tanks.

b. Commercial Craft

The river has considerable commercial use. There are 29 commercial towboats operating on the Missouri River. There were 319 tows during 1968 with an average of 15 tows on the river daily, with a total operation of 97,700 hours during the year. Table IV-B-2 shows the operating time in 1966 and the types of waste disposal provided on the commercial and Federal boats.

A trial run of transporting cattle by barge apparently was quite successful and there may be additional barging of cattle on the river. Should this practice be continued, it could result in considerable pollution with the washing overboard of animal wastes.

c. Accidental Spills and Discharges

Accidental spills may result from collisions, sinking of barges or the loss overboard of open containers. Spills may also result from the servicing of boats which could introduce oil, gasoline or grease into the water. This discharge of petroleum material may result in fire hazards and affect taste and odor of water used for domestic purposes. Discoloration of vessels, piers, docks and other water structures will also occur.

Serious land-based spills have occurred. One resulted from a fire at a chemical plant in Omaha. Two were the result of a ruptured storage tank of fertilizer chemical in the Sioux City area. Public water supplies were endangered and a fish kill occurred.

5. Agricultural Waste Sources.

The study area in Iowa includes the western reaches of the Corn Belt with extensive feeding areas of both cattle and hogs. It includes the drainage area of the Big Sioux River below Sioux Falls and the Missouri River from Sioux City, Iowa, downstream to St. Joseph, Missouri.

Surveillance station data indicate that the Nebraska-Iowa-Missouri reach of the Missouri River at times carries an organic pollution burden equal to that of the discharge of the untreated wastes of 30,000,000 people. This loading, then exceeds by 10 times the human population of the entire basin. The pollution of the basin caused by industrial activity may equal that of the population; therefore, the balance must

TABLE IV-B-2

Commercial and Federal Watercraft Operating in the Missouri Basin

				Op. Time 1966			
Type Craft	Owned or Operated By	Avg. Pass. & Crew Ea. Boat	No Craft in Operation	Avg. Days Per Boat	Hrs. Per Day	Months	Type Disposal
Dredge	Army Engrs., Omaha	53	1	0	0	0	Central Aerobic
Towboat	Army Engrs., Omaha	2	4	150	8		Package Maceration
Launch	Army Engrs., Omaha	2	4	40	8		Package Maceration
Survey Boat	Army Engrs., Omaha	2	1	176	8		Package Maceration
Survey Boat	Army Engrs., Omaha	3	2	150	8		Package Maceration
Cutter	Coast Guard	13	2		24	9 ea.	Package Maceration
Work Boats	River Const. Cntrctrs.	3	44	170	8		None
Pile Driver	River Const. Cntrctrs.	8	18	70	8		None
Towboats	Commercial Barge Lines	14	*29	**258	24		None

*Total of 29 commercial towboats in Missouri River service and an average of 15 are in river daily.

**258 is average for 15 towboats with total operation 93,000 hours for 1966. Total number of trips in 1966 was 359.

represent that caused by agricultural endeavors and so-called natural sources.

The main causes of agricultural associated water pollution are: (1) sediments; (2) nutrients; (3) chemicals; and (4) animal wastes.

Some four billion tons of sediment are washed into tributary streams in the United States each year. The estimated losses incurred by such pollution and the inherent problems cost the American people half a billion dollars annually. Heavy rains cause large amounts of silt, debris and other solid materials to be carried into the river. As the river level rises, turbidity, the biochemical oxygen demand (BOD) and bacterial count increase tremendously. After the river crests and falls back to lower stages, the turbidity, BOD and bacterial count all decline. This physical and biological pollution phenomena is largely the result of agricultural operations.

Land runoff and natural drainage contribute significant quantities of silt and other materials which are carried as a suspended load by the Missouri River. The silt portion, including valuable top soil is reflected by the four-fold increase in turbidity observed between Gavins Point Dam and St. Joseph. The sediment load causes economic damages to water users as exemplified by increased water treatment costs at municipalities, high channel and harbor maintenance costs for navigation interests, depressed esthetic values for recreational uses, and fish kills associated with sediment clogged gills.

Land runoff can increase the bacteriological content and the nutrient level of the waters. Fertilizer usage is extensive in Iowa. Iowa is number 2 in the Nation in consumption of primary plant nutrients using 636,250 tons of N, 345,656 tons available P_2O_5, 282,308 tons of K_2O

for a grand total of 1,264,214 tons of fertilizer in the year ending June 30, 1968. This represents approximately nine percent of the total fertilizer used in the United States.

Studies on land runoff have shown that 10-25 percent of the fertilizers applied to the land may be lost through drainage.

Iowa is the leading State in the United States in the production of swine and beef cattle and is among the leaders in the production of other meat animals. There are approximately 46,000 feeder lots in the State and the 1967 marketing statistics show four million fifty-seven thousand beef cattle sold. The population equivalent (P.E) of livestock on Iowa farms in the Missouri drainage, based on the BOD of the animal wastes, is over 65 million. This includes approximately 3,300,000 cattle and calves and 6,100,000 hogs and pigs on farms.

MUNICIPAL DISCHARGES TO MO. RIVER - YANKTON TO RULO

		Estimated Present Conditions							
River Mile	City	P.E. Raw B.O.D.	Q mgd	% BOD removed	Discharge P.E. (B.O.D.)	Design Q mgd	Design P.E.	Grant Amt.	Total Cost
840.4	Yankton, S.D.	12,000	1.2	35	7,800	1.78	17,800	108,593	361,978
806.1	Vermillion, S.D.	6,100	0.50	85	915	1.119	15,000	119,618	421,800
790.1	Elk Point, S.D.	1,350	0.10	90	135	0.20	1,600	15,172	50,574
760.0	Sioux City, Ia.	300,000	17.0	35	195,000	17.5	317,500	805,856	6,977,237
753.6	Dakota City, Nebr.	800	0.05	35	520	0.10	2,000	23,460	79,000
716.9	Decatur, Nebr.	680	0.04	75	170	0.05	800	--	--
670.0	Blair, Nebr.	4,500	0.243	35	2,920	0.80	7,120	41,226	137,442
655.0	Fort Calhoun, Nebr.	450	--	85	67	0.50	500	7,518	25,062
632.0	Council Bluffs, Ia.	60,000	--	35	39,000	10.4	78,000	250,000	1,495,352
631.4	Omaha, Nebr. *	1,890,000	40.0	5	1,801,640	73.0	2,000,000	1,999,830	21,654,234
618.1	Bellevue, Nebr.	10,000	0.50	35	6,500	0.90	10,000	68,973	241,668
607.5	Plattsmouth, Nebr.	6,000	0.425	40	3,600	0.70	7,000	88,709	295,699
579.3	Nebraska City, Nebr.	20,000	1.26	35	13,000	1.68	25,300	133,887	443,943
561.2	Peru, Nebr.	1,700	0.102	85	255	0.20	2,160	15,678	53,300

* Currently providing primary treatment for 220,900 PE

IOWA MUNICIPAL DISCHARGES TO INTERSTATE STREAMS - MISSOURI RIVER BASIN

City	Receiving Stream	Estimated Present Conditions P.E. Raw B.O.D.	Q gpd	% BOD removed	Discharge P.E. (B.O.D.)	Design Q gpd	Design P.E.	Grant Amt.	Total Cost
Chariton	Chariton River	4,800	358,000	85	720	720,000	7,320	--	--
Greenfield	Thompson R.	2,000	--	85	300	272,000	2,900	42,840	145,384
Hamburg (1)	Nishnabotna R.	1,000	--	0	1,000	252,000	2,100	41,010	124,300
Carter Lake	-	2,000	--	Served by Omaha, Nebr. plant				3,530	11,791
Council Bluffs	Mo. R.	60,000	--	35	39,000	10,400,000	78,000	250,000	1,495,352
Sergeant Bluff	-	800	--	Interceptor to Sioux City now under construction - treatment at A.F.B. now					
Sioux City A.F.B.	-	De-activated - Minor amount of flow at present - Will be intercepted by Sioux City							
Sioux City	Mo. R.	300,000	17,000,000	35	195,000	17,500,000	317,500	805,856	6,977,237
Anthon	Little Sioux R.	650	35,000	38	400	30,000	600	--	--
Correctionville	" " "	900	60,000	22	700	--	700	--	--
Washta	" " "	310	--	35	200	--	--	(2)	--
Quimby	" " "	330	--	87	75	--	--	--	--
Cherokee	" " "	7,200	--	86	1,018	600,000	6,516	--	--
Peterson	" " "	600	--	85	90	43,000	648	--	--
Linn Grove	" " "	300	--	80	60	30,000	350	--	--
Sioux Rapids	" " "	1,000	--	85	150	64,000	1,140	20,363	67,876
Spencer	" " "	72,000	1,500,000	79	15,000	1,740,000	71,750	191,475	640,266
Akron	Big Sioux R.	1,200	--	85	180	134,000	1,500	39,240	130,800
Hawarden	" " "	2,500	--	0	2,500	--	--	92,100	307,000
Rock Valley	Rock R.	1,500	--	35	975	--	--	(2)	
Rock Rapids	" "	3,500	--	86	500	379,000	4,221	--	--
Allerton	Mid.Fk.Medicine Cr.	3,750	45,000	60	1,500	60,000	1,950	--	--
Leon	Little R.	2,000	48,000	55	900	147,000	1,938	--	--
Lamoni	E. Fk. Big Creek	2,800	--	85	420	261,000	4,250	42,900	167,177
Creston	Platte R.	7,500	612,000	87	1,000	900,000	8,500	84,750	282,500
Lenox	E. Fk. 102 R.	800	--	85	120	154,000	1,547	17,214	62,758

IOWA MUNICIPAL DISCHARGES TO INTERSTATE STREAMS - MISSOURI RIVER BASIN

City	Receiving Stream	Estimated Present Conditions P.E. Raw B.O.D.	Q gpd	% BOD removed	Discharge P.E. (B.O.D.)	Design Q gpd	Design P.E.	Grant Amt.	Total Cost
Bedford	E. Fk. 102 R.	1,800	--	90	270	400,000	5,154	35,400	118,000
Stanton	Tarkio, R.	450	--	22	350	--	--	(2)	
Everly	Ocheyedan R.	700	30,000	85	105	60,000	900	36,690	122,300
Ocheyedan	" "	729	20,000	85	110	36,000	729	7,773	30,382

(1) Project under construction (2) Reimbursable grant project

MUNICIPAL DISCHARGES TO IOWA INTRASTATE STREAMS - MISSOURI RIVER BASIN

		Estimated Present Conditions							
City	Receiving Stream	P.E. Raw B.O.D.	Q gpd	% BOD removed	Discharge P.E. (B.O.D.)	Design Q gpd	Design P.E.	Grant Amt.	Total Cost
Centerville	Cooper Cr.	2,000	--	85	300	136,000	2,180	--	--
Centerville	" "	4,470	--	85	670	270,000	4,470	(2)	
Humeston	S.FK. Chariton R.	500	--	85	75	65,000	650	14,910	54,900
Corydon N.E.	Dry run	920	--	85	138	35,000	700	--	--
" S.E.	" "	60	--	85	9	6,000	120	--	--
" S.W.	" "	60	--	85	9	6,000	120	--	--
" S.	" "	500	--	85	75	54,000	1,080	--	--
Seymour	Shoal Cr.	630	--	36	400	--	--	--	--
"	" "	200	--	40	120	--	--	--	--
Mt. Ayr	Mid.Fk. Grand R.	1,700	--	85	255	129,000	1,950	28,574	95,246
Corning	E. Nodaway R.	1,800	--	70	540	187,000	2,200	--	--
Clarinda	W. Nodaway R.	7,100	--	86	1,000	623,000	9,078	--	--
Villisca	W. Nodaway R.	1,500	--	85	225	126,000	2,114	32,366	107,887
Massena	W. Nodaway R.	400	30,000	85	60	50,000	565	12,040	44,062
Macedonia	W. Nishnabotna R.	290	--	85	44	30,000	300	--	--
Carson	" " "	400	--	85	60	49,000	700	31,110	103,700
Oakland	" " "	1,100	--	0	1,100	--	--	(2)	--
Hancock	" " "	220	--	0	220	--	--	--	--
Harlan	" " "	4,000	--	85	600	412,000	3,654	--	--
Irwin	" " "	400	--	85	60	45,000	600	--	--
Manning	" " "	2,000	--	85	300	198,000	2,886	--	--
Sidney	Dry run	900	--	85	135	100,000	1,100	--	--
Walnut	Walnut Cr.	700	--	79	150	104,000	1,010	--	--
Malvern	Silver Cr.	2,000	--	0	2,000	--	--	--	--
Shelby	" "	350	--	34	230	--	--	--	--
Treynor	Mid-Silver Cr.	250	--	85	35	40,000	400	--	--

MUNICIPAL DISCHARGES TO IOWA INTRASTATE STREAMS - MISSOURI RIVER BASIN

City	Receiving Stream	Estimated Present Conditions P.E. Raw B.O.D.	Q gpd	% BOD removed	Discharge P.E. (B.O.D.)	Design Q gpd	Design P.E.	Grant Amt.	Total Cost
Treynor	Mid-Silver Cr.	75	--	87	10	15,000	150	--	--
Emerson	Indian Cr.	450	--	82	80	21,000	512	--	--
Avoca	E.Br.W. Nishnabotna R.	2,700	--	0	2,700	--	--	--	--
Manilla	W.Fk.W. Nishnabotna R.	800	--	85	120	102,000	1,020	15,300	51,000
Tabor	Plum Creek	800	--	85	120	72,000	1,100	24,657	82,192
Fontanelle	Mid Nodaway R.	650	--	85	100	54,000	900	--	--
Cumberland	Seven Mile Cr.	350	--	86	50	51,000	510	--	--
Farragut	E. Nishnabotna R.	350	--	84	55	32,000	650	17,010	56,700
Shenandoah	" " "	7,000	--	85	1,050	1,050,000	7,620	121,382	404,608
Essex	" " "	650	--	85	97	166,000	844	--	--
Red Oak	" " "	6,700	550,000	85	1,000	796,000	8,612	115,853	386,175
Elliot	" " "	450	--	86	65	74,000	620	18,180	60,600
Griswold	" " "	1,000	--	85	150	95,000	1,420	--	--
Atlantic	" " "	6,200	--	90	600	880,000	7,410	--	--
Exira	" " "	1,350	75,000	83	230	50,000	1,530	--	--
Elk Horn	Indian Cr.	700	--	84	100	83,000	830	--	--
Anita	Turkey Cr.	800	--	85	120	140,000	1,400	23,864	79,550
Audubon	Blue Grass Cr.	2,200	190,000	91	200	250,000	2,700	--	--
Hinton	Floyd R.	300	--	0	300	--	--	--	--
Merrill	" "	400	--	85	60	82,460	910	24,120	73,100
Le Mars	" "	20,000	--	85	3,000	1,950,000	26,100	148,660	450,500
Alton	" "	1,075	67,000	85	161	120,000	1,200	16,510	55,032
Orange City	" "	3,000	110,000	90	300	234,000	3,762	38,632	147,946
Hospers	" "	2,000	--	85	300	106,000	2,042	20,313	67,713
Sheldon	" "	700	--	85	105	20,900	704	--	--
Sheldon	" "	3,800	200,000	85	570	415,000	7,086	--	--

MUNICIPAL DISCHARGES TO IOWA INTRASTATE STREAMS - MISSOURI RIVER BASIN

City	Receiving Stream	Estimated Present Conditions P.E. Raw B.O.D.	Q gpd	% BOD removed	Discharge P.E. (B.O.D.)	Design Q gpd	Design P.E.	Grant Amt.	Total Cost
Maurice	W. Br. Floyd R.	210	--	28	150	30,000	300	--	--
Boyden	" " " "	540	30,000	85	81	98,000	1,500	44,970	49,938
Brunsville	Mink Cr.	175	--	83	30	29,000	300	--	--
Sioux Center	Dry run	4,000	300,000	85	600	345,000	5,360	70,126	233,752
Oyens	Deep Cr.	100	--	85	15	10,000	95	--	--
Remsen	" "	1,400	65,000	85	210	89,000	1,920	47,324	--
Granville	Willow Cr.	300	--	33	200	--	--	(2)	--
Sanborn	Little Floyd R.	4,000	100,000	85	600	176,000	5,052	--	--
Ruthven	Drainage Ditch	1,000	--	85	150	121,000	1,253	7,997	26,657
Ia.Great Lakes	Okoboji	4,000	55,000	85	600	1,500,000	23,610	--	--
Lake Park	W. Fk. L. Sioux	1,000	--	85	150	83,000	1,200	--	--
Blencoe	McNeil Ditch	250	--	86	35	30,000	300	13,293	44,312
Onawa	" "	4,000	--	85	600	200,000	5,262	--	--
Whiting	Cleghorn Ditch	520	--	85	80	65,000	650	14,155	47,185
Sloan	" "	600	--	85	90	90,000	900	--	--
Ute	E. Soldier R.	350	--	35	228	23,000	460	--	--
Charter Oak	" " "	550	26,000	35	360	--	--	(2)	--
Ricketts	Mid. Soldier R.	100	--	40	60	--	139	--	--
Schleswig	Dry run	750	90,000	85	110	95,000	950	--	--
Mapleton	Maple R.	2,200	--	36	1,400	--	--	--	--
Danbury	" "	500	--	85	75	102,000	600	20,730	69,100
Battle Creek	" "	550	--	0	550	--	--	--	--
Ida Grove	" "	2,200	200,000	85	480	240,000	2,500	--	--
Galva	" "	300	--	83	50	45,000	540	--	--
Aurelia	" "	900	108,000	86	130	127,000	810	--	--
Holstein	Battle Cr.	1,400	75,000	85	210	130,000	1,416	--	--

MUNICIPAL DISCHARGES TO IOWA INTRASTATE STREAMS - MISSOURI RIVER BASIN

		Estimated Present Conditions							
City	Receiving Stream	P.E. Raw B.O.D.	Q gpd	% BOD removal	Discharge P.E. (B.O.D.)	Design Q gpd	Design P.E.	Grant Amt.	Total Cost
Arthur	Odebolt Cr.	235	--	85	35	36,000	360	10,620	35,400
Odebolt	" "	1,330	130,000	80	266	187,000	2,058	--	--
Schaller	Halfway Cr.	900	--	85	135	113,000	1,170	17,880	59,600
Glenwood	Keg Creek	3,900	--	90	390	425,000	4,360	107,471	358,240
Minden	" "	400	40,000	85	60	45,000	450	--	--
Underwood	Mosquito Cr.	300	--	85	45	77,000	815	--	--
Neola	" "	800	--	50	400	43,000	870	--	--
Earling	" "	350	--	86	50	56,000	772	--	--
Logan (1)	Boyer R.	2,000	--	0	2,000	--	--	50,970	178,500
Woodbine	" "	1,000	--	85	150	125,000	1,414	25,590	85,300
Dunlap	" "	1,200	--	85	180	180,000	1,500	26,369	79,906
Dow City	" "	400	--	85	60	80,000	800	13,828	46,095
Denison (1)	Boyer R.	4,500	--	0	4,500	--	--	339,430	1,028,600
Wall Lake	" "	700	50,000	85	105	108,000	1,030	24,180	80,600
Early	" "	700	--	43	400	--	--	--	--
Mo. Valley	Willow Cr.	4,000	--	85	600	433,000	4,326	81,600	272,000
Vail	E. Fk. Boyer R.	350	--	0	350	--	--	--	--
Westside	" " " "	300	--	33	200	53,000	430	--	--
Kiron	Otter Cr.	230	20,000	85	35	26,000	396	--	--
Mondamin	Spooner Ditch	350	--	84	55	41,000	624	15,910	53,035
Alta	Little Maple R.	1,800	93,000	80	360	117,000	1,900	(2)	--
Moville	W. Fk.Little Sioux R.	1,050	150,000	33	700	--	--	--	--
Kingsley	" " " " "	1,000	60,000	85	150	90,000	1,350	18,150	55,000
Lawton	Elliott Cr.	300	--	85	45	37,000	470	--	--
Marcus	Fiddle Cr.	2,000	70,000	85	300	116,000	2,100	28,713	95,711
Cushing	Bacon Cr.	220	20,000	36	140	--	260	--	--

MUNICIPAL DISCHARGES TO IOWA INTRASTATE STREAMS - MISSOURI RIVER BASIN

		Estimated Present Conditions							
City	Receiving Stream	P.E. Raw B.O.D.	Q gpd	% BOD removal	Discharge P.E. (B.O.D.)	Design Q gpd	Design P.E.	Grant Amt.	Total Cost
Pierson	Pierson Cr.	400	--	75	100	--	--	--	--
Paullina	Mill Cr.	1,500	150,000	85	225	183,000	1,500	28,796	95,987
Primghar	" "	900	60,000	85	135	135,000	1,350	14,618	48,727
Sutherland	Waterman Cr.	900	--	85	135	90,000	1,484	--	--
Hartley	Drainage Ditch	2,800	138,000	85	420	194,000	3,924	--	--
Harris	Dry run	250	10,000	33	168	23,750	250	--	--
Ireton	Indian Cr.	800	--	85	120	65,000	900	21,721	72,403
Hull	Burr Oak Cr.	2,500	--	88	300	130,000	3,084	(2)	--
Doon	Little Rock R.	400	20,000	35	260	--	--	--	--
George	" " "	1,000	--	85	150	108,850	1,300	27,840	92,800
Little Rock	" " "	400	24,000	62	150	30,000	300	--	--
Ashton	Otter Cr.	550	20,000	85	80	60,000	630	15,420	51,400
Sibley	" "	11,000	400,000	90	1,100	420,000	11,580	75,658	254,192
Larchwood	Blood Run Cr.	450	--	84	70	50,000	675	--	--

(1) Project under construction (2) Reimbursable grant project

IV-C - IMPACT OF WATER QUALITY ON USE

Current information on the changes in water quality of the Missouri River as the reach between Gavins Point Dam and St. Joseph is available from two sources. These are the FWPCA water quality monitoring stations at Yankton, South Dakota; Omaha, Nebraska; and St. Joseph, Missouri and the results from the baseline survey conducted in October 1968 and January 1969. These data demonstrate significant quality degradation downstream from the Iowa-South Dakota Border.

Samples from the Gavins Point Dam releases and at the Yankton, South Dakota monitoring show a relatively high quality water suitable for all recognized beneficial uses. Turbidity, nutrient, dissolved organics and bacterial indicator organism concentrations are low and the biological habitat reflects essentially non-polluted conditions.

Downstream from the Sioux City area the effects of waste discharges are immediately reflected by the water quality changes. Densities of bacterial indicator organisms increase significantly. Concentrations of quality parameters indicative of recent pollution such as nutrient levels (nitrogen and phosphorus), dissolved organics, cyanides and phenol are increased. There is also serious destruction of the aquatic habitat in the Sioux City area.

Below the Omaha-Council Bluffs metropolitan area the river quality again reflects the impact of waste discharges. The aquatic habitat for a distance of 54 miles downstream supports numbers of pollution tolerant organisms. Densities of bacterial indicator organisms increase sharply. The concentrations of dissolved organics as measured by BOD and the nutrient concentrations are significantly higher.

Overall, there is a significant deterioration of water quality between Gavins Point Dam and St. Joseph, Missouri. This degradation is the result of point source pollution from municipalities and industries and from siltation caused by land runoff. The existing data show a constantly increasing suspended load of pollutants and turbidity carried by the Missouri River. Detailed reports on the physical, chemical and biological quality are contained in Appendixes A, B, and F.

The physical, chemical and biological characteristics of an area's water resource have an important impact on regional development patterns, overall economics and esthetic well-being of the area residents.

The eight major use categories considered applicable to the main stem reach of the Missouri River under consideration in the conference report are discussed in Section IV-A. How these use categories are affected by present water quality conditions will be considered here.

In the National Technical Advisory Committee Report on "Water Quality Criteria" (April 1, 1968), the Subcommittee on Public Water Supplies developed a tabulation of desirable criteria for waters for public consumption. Certain of these criteria are shown in Table IV-C-1.

It can be assumed that if a raw water source which consistently

TABLE IV-C-1 SURFACE WATER CRITERIA FOR PUBLIC WATER SUPPLIES

Constituent or Characteristic	Permissible Criteria	Desirable Criteria
Physical:		
Color (color units)	75	<10
Odor		Virtually absent
Temperature*	do	Narrative
Turbidity	do	Virtually absent
Microbiological:		
Coliform organisms	10,000/100 ml[1]	<100/100 ml[1]
Fecal coliforms	2,000/100 ml[1]	<20/100 ml[1]
Inorganic Chemicals:	(mg/l)	(mg/l)
Alkalinity	Narrative	Narrative
Ammonia	0.5 (as N)	<0.01
Arsenic*	0.05	Absent
Barium*	1.0	do
Boron*	1.0	do
Cadmium*	0.01	do
Chloride*	250	<25
Chromium,* hexavalent	0.05	Absent
Copper*	1.0	Virtually absent
Dissolved oxygen	≥4 (monthly mean) ≥3 (individual sample)	Near saturation
Fluoride*	Narrative	Narrative
Hardness*	do	do
Iron (filterable)	0.3	Virtually absent
Lead*	0.05	Absent
Manganese* (filterable)	0.05	do
Nitrates plus nitrites*	10 (as N)	Virtually absent
pH (range)	6.0-8.5	Narrative
Phosphorus*	Narrative	do
Selenium*	0.01	Absent
Silver*	0.05	do
Sulfate*	250	<50
Total dissolved solids* (filterable residue).	500	<200
Uranyl ion*	5	Absent
Zinc*	5	Virtually absent

*Most Common Treatment Processes Have Little Effect on This Constituent.

1/ See Original Reference for Discussion.

showed these desirable characteristics were available, it would represent the safest, cheapest possible source of domestic supply. This situation is not encountered frequently in major urban areas and hence consumers must either settle for water of less desirable characteristics or pay additional monies to have the water quality improved by treatment processes. Fortunately treatment processes exist which, at a price, can convert almost any water including grossly polluted fresh water into a potable product. However, since the price of delivered water is proportional to the quality of raw water source, prevention of water quality degradation is of benefit to each consumer and water treatment becomes of importance to all water users in downstream locations.

The survey information demonstrates the presence of materials in sufficient concentrations which present problems to water treatment plants. The high bacterial densities observed during normal flows were in excess of those commonly accepted by standard public health practice. Heavy silt loads increased treatment costs and created sludge disposal problems and short filter runs. Phenols and other organic material when combined with chlorine can result in taste and odor problems causing consumer complaints. The presence of ammonia in high concentrations greatly increases the chlorine demand resulting in higher water treatment costs. During storm runoff these problems are intensified.

During the synoptic survey conducted by the Department of the Interior certain conditions, as outlined below, were discovered which indicate substantial degradation of the water source from controllable waste discharges. The geometric mean coliform densities at all stations downstream from Sioux City, Iowa in the reach being considered were in excess of desirable criteria. Nutrient levels encountered in the stream increased below the first major waste source on the main stem and throughout the reach under consideration.

The levels of nutrients created are adequate to support excessive biologic growths and generate taste and odor problems in water supplies.

Water quality requirements for industrial uses vary widely but the same general development as used for public supplies will hold in this category. In addition, it should be noted that desirable criteria for contact recreation use are more stringent than for public water supply.

In the case of esthetic appreciation and recreational values, desirable characteristics expressed in "Water Quality Criteria" are in Table IV-C-2.

During the survey conducted by FWPCA personnel, many observations were made which demonstrated a direct contravention of quality shown in the above Table. The survey biologists found areas of severe biological habitat degradation. Many of the benthic organisms found were those associated with polluted water. Significant quantities of floating debris including greaseballs the size of oranges were seen in the river. Traces of phenolics were measured in the water. Phenol when combined with chlorine will impart offending tastes.

The undesirable esthetic and hazardous conditions created by solid, floating, suspended, and dissolved material to boaters, water skiers, waders, and fishermen demonstrates the need for improvements in waste treatment. The possible disease agents present with these

Table IV-C-2
Water Quality Criteria For Esthetics And Recreation

A. General Requirements For Esthetics

I. All surface waters should be capable of supporting life forms of esthetic value.

II. Surface waters should be free of substances attributable to discharges or wastes as follows:

(a) Materials that will settle to form objectionable deposits.

(b) Floating debris, oil, scum, and other matter.

(c) Substances producing objectionable color, odor, taste, or turbidity.

(d) Materials, including radionuclides, in concentrations or combinations which are toxic or which produce undesirable physiological responses in human, fish, and other animal life and plants.

(e) Substances and conditions or combinations thereof in concentrations which produce undesirable aquatic life.

B. Primary Contact Recreation Requirements

I. Criteria for mandatory factors.

(a) Fecal coliform should be used as the indicator organism for evaluating the microbiological suitability of recreation waters. As determined by multiple-tube fermentation or membrane filter procedures and based on a minimum of not less than five samples for any 30-day period of the recreation season, the fecal coliform content of primary contact recreation waters shall not exceed a log mean of 200/100 ml, nor shall more than 10 percent of total samples during any 30-day period exceed 400/100 ml.

(b) In primary contact recreation waters, the pH should be within the range of 6.5 - 8.3 except when due to natural causes and in no case shall be less than 5.0 nor more than 9.0. When the pH is less than 6.5 or more than 8.3, discharge of substances which further increases unfavorable total acidity or alkalinity should be limited.

materials and the hazard presented to persons handling boats and other gear coming in contact with these waters should not be overlooked. In addition, this debris in the river can cause significant damages to equipment. The fouling of fish nets and boat hulls results in many dollars in maintenance by the owners. Many boaters have suffered engine failures due to the destruction or clogging of cooling water pumps by silt. The larger more solid debris, when hit by a moving boat, can puncture boat hulls with ease, causing a real danger to life and limb. The potential for pathogenic organisms to be present is thoroughly documented by the high total and fecal coliform densities measured in the river samples. In common terms, densities of coliform indicators found vary during normal flows from 2 to 250 per drop. During storm flows these levels may rise as high as 2000 per drop.

The main stem, as it flows through or by Iowa, Nebraska, Kansas and Missouri, forms the historic center of Missouri River commercial fishing. Available records indicate that no significant commercial fishery existed on the upper main stream in Montana and North Dakota until the advent of the main stem reservoirs.

Carp, buffalo and catfish have dominated the annual production of river fishes since 1908. These species have consistently comprised over 92 percent of the catch. A progressive decline has occurred in annual production since 1908. In 1963 total production was 12 percent of that of the 1908 catch, although showing constant percentages of the three primary groups--carp, buffalo and catfish. Since 1908 there has also been an accompanying decrease in numbers of commercial fishermen within the four-state area. These declines are at least partially attributed to a progressive degradation of Missouri River water quality. In particular, some of the recent decrease in fishing pressures both in the commercial and private sector can be attributed to complaints concerning fish flesh tainting. Technical studies to identify compounds which taint fish flesh are a relatively undeveloped and difficult study area. Definitive results and clarification of the magnitude of the tainting problem and its specific causes will be difficult to obtain.

Closely related to the fishing resource is the use for wildlife habitat. Thirteen separate conservation or designated waterfowl hunting areas are located within the study reach. In addition perhaps, several hundred private "blinds" are constructed in the study reach during the fall months of the migration period.

It is axiomatic that water quality that can be tolerated by, and is productive of fish and their food organisms is generally adequate for waterfowl and their habitat. Indeed, fish and many of the organisms upon which they feed are also important in the diet of many species of wildlife; e.g., loons, mergansers, other ducks, herons, otters, raccoons, etc. It is obvious that requirements for survival of fish and aquatic organisms also constitute the same requirements for preservation of the wildlife habitat.

Very little attention has been given to the optimum quality of drinking water for farm animals. While the standards of quality for human consumption may not be justified for farm animals, there are certain contaminants which may be hazardous to livestock. The danger of direct infection to livestock through the consumption of water contaminated with pathogenic agents is a possibility and deserves attention.

Protection of water quality for other agricultural uses involves similiar safeguards to industrial and domestic criteria. The potential of this water resource to provide a supplemental irrigation supply for food production should not be destroyed or allowed to be degraded.

Water quality requiremnnts for commercial navigation are not critical if demands for other use categories are met. It should be recognized that benefits from water quality enhancement for other purposes will also cause benefits to accrue in the areas of esthetics and health protection to those same persons involved in navigation activities.

Review and comparison of data available make it clear that man and his activities have caused and are now causing substantial degradation of water quality and causing damages to the beneficial use potentials in the reach of the Missouri River between Sioux City, Iowa and St. Joseph, Missouri.

IV-D - MONITORING

Water quality monitoring in the Missouri River drainage of Iowa should accomplish the objectives of providing baseline water quality information and determining compliance with water quality standards.

Baseline water quality data are obtained for determining long term quality trends of the major streams and for determining water quality of streams where information is lacking or incomplete. This information is used in water quality management.

In accomplishing the second objective, determining compliance with water quality standards, water quality data are obtained to detect violations of stream quality criteria established by the State standards and detect pollutants which interfere with the legitimate uses of streams. This requires a monitoring effort involving: (1) establishing stream sampling stations above and below major or significant waste outfalls; (2) selecting parameters pertinent to measuring effects of various types wastes discharges on stream water quality; (3) adopting an optimum sampling frequency at monitoring stations, particularly on streams where rapid changes in stream quality can occur from slug discharges of treated and untreated wastes. The following measures should be taken in developing and operating a comprehensive monitoring network on the streams which affect the quality and uses of interstate waters:

1. Acquire and analyze basic water pollution control information to determine monitoring needs. This would require the following: (a) assessing treatment facilities of all municipalities, industries and agri-industries through studies of existing information collected and through on-site investigations; and (b) assessing historical and

current water quality data and conducting stream surveys on streams where water quality information is inadequate or lacking.

2. Develop a cooperative monitoring plan through agreements between all local, State and Federal agencies engaged in stream sampling activities. The implementation of a cooperative monitoring plan would accomplish the following: (a) minimize duplication of monitoring efforts; (b) permit an optimum number of stations to be operated; (c) satisfy the water quality parameter needs of all entities; and (d) facilitate the exchange of water quality and related data between all agencies concerned with water quality problems.

3. The scheduled sampling frequencies of existing and proposed monitoring stations operated by the Iowa Water Pollution Control Commission are on a quarterly basis for physical, chemical and bacteriological parameters. The sampling frequencies for these parameters should be increased to at least weekly intervals on the following streams:

a. Missouri River
b. Big Sioux
c. Rock River
d. Little Sioux River
e. Nishnabotna River
f. Nodaway River
g. East Fork of 102 River
h. Chariton River
i. Floyd River
j. Boyer River

4. Monitoring stations should be established on the following interstate streams:

a. Middle Fork Medicine River

b. Weldon River

c. Little River

d. Thompson River

e. Middle Fork of 102 River

f. West Tarkio River

g. Tarkio River

h. Grand River

i. Platte River

j. East Fork of Big River

(NOTE: A listing of proposed and existing Federal and State monitoring stations is shown in Appendix D)

V. QUALITY CRITERIA NECESSARY TO SUPPORT EXISTING AND FUTURE WATER USES

A. Treatment

The degree of waste treatment consistent with the protection of all stipulated beneficial uses and with the purposes and intent of the Federal Water Pollution Control Act must be stated in the water quality standards. The present and future water uses recognized for the conference area are already impaired by quality degradation. Consequently, secondary treatment, including at least 85% removal of BOD, is required.

B. Disinfection

The protection of public water supplies, certain industrial uses, full and partial body contact sports, including swimming, water skiing, wading and fishing, requires a maximum reduction or elimination of opportunity for individual contact with disease producing agents. Since municipal waste discharges are a major source of pathogenic organisms, disinfection of these wastes is mandatory.

C. Temperature

Temperature, a catalyst, a depressant, an activator, a restrictor, a stimulator, a controller, a killer, is one of the most important and most influential water quality characteristics to life in water. Temperature determines those species that may be present; it activates the hatching of young, regulates their activity and stimulates or suppresses their growth and development; it attracts and kills when the water becomes too hot or becomes chilled too suddenly. Colder water generally suppresses development; warmer water generally accelerates activity and may be a primary cause of aquatic plant nuisances when other environmental factors are suitable.

Temperature is also a factor in recreational enjoyment. Excessively high temperatures may lessen the pleasure of water contact sports. The maximum water temperature that will not induce undesirable physiological effects after prolonged exposure must be less than 90° F. with 85° F. considered the safe maximum limit for continuous exposure for several hours. Limited exposure to water warmer than 85° F. can be tolerated for short periods of time without causing undesirable physiological effects, especially under unique circumstances such as bathing in hot springs where physical exertion is limited.

For waters serving as a raw water source for domestic uses, temperature is an important factor. From an esthetic viewpoint, water over 85° F. loses its desirability and appeal. Over a 1° F. hourly temperature variation adversely affects the coagulation in the treatment process. Rapid changes in temperature or excessive temperatures which kill the stream biota can ultimately result in taste and odor problems.

D. Nondegradation

The declaration of policy contained in the Federal Water Pollution Control Act states that the purpose of the Act is to enhance the quality and value of the Nation's water resources. Enhancement of quality can be achieved only through improving existing low quality water, protecting high quality waters and in no case permitting further degradation of existing quality. Therefore, it is imperative that all water quality standards, in order to be consistent with the purposes and intent of the Act, contain a statement of policy concerning nondegradation.

E. Radioactivity

Water treatment plants remove little radioactive pollution from raw water supplies. The Department of the Interior is interested in upgrading radiological criteria to conform to the latest recommendation of Federal agencies. Iowa concurs with this objective.

F. Standards of Related States

One of the guidelines designated by the Department of the Interior to be used in establishing water quality standards for interstate waters was that the State standards were to be reviewed in terms of their consistency and comparability with those for affected waters of downstream or adjacent states. The results of this review are reflected in the items excepted from the Secretary of the Interior's approval of Iowa's standards. With regard to these items, the following paragraphs summarize the criteria and requirements from the standards of states adjacent to or downstream of Iowa.

1. Treatment

Every state which borders on the Missouri River, with the exception of Iowa, has adopted as part of its standards a minimum requirement of secondary treatment or its equivalent for wastes discharged into the Missouri River. The language used by these states varies, but all essentially have this requirement. The final compliance dates for implementation of secondary treatment vary with each State.

The Nebraska standards for the Missouri River provide for a minimum of secondary treatment. These standards have been approved by the Secretary of the Interior. Nebraska treatment facilities shall be in operation prior to completion of equivalent downstream facilities. The December 1982 date for Missouri is the final compliance date. An earlier compliance date will be required when survey results show such a need. The Kansas standards for the Missouri River provide for the best practicable treatment of all significant wastes. The Kansas standards have not been approved by the Secretary of the Interior.

2. Disinfection

All of the states adjoining Iowa in the Missouri River Basin have established acceptable bacterial criteria for interstate waters. Minnesota, Nebraska, and Missouri have set limits on the bacterial concentrations for all interstate waters and all uses in the Missouri River Basin. South Dakota has set limits on the bacterial concentrations on domestic water supply, fish life propagation, recreation, and irrigation uses. The criteria in Missouri are not applicable when streams are affected by storm water runoff. Minnesota standards require the effective disinfection of any discharges, including combined flows of sewage and storm water, where necessary to protect the specified uses of the interstate waters.

3. Temperature

Minnesota has established temperature criteria on these waters which limit the temperature increase to 5° F. above ambient temperature except in Class A fishery waters where no increase is permitted or to a maximum temperature as shown in the following table:

Maximum Temperatures °F.

Class of Water	Ja	F	Mr	Ap	My	Jn	Jl	Ag	Se	Oc	N	D
2A Fisheries & Recreation	No material increase above natural											
3A Industrial Consumption	35	35	40	50	60	70	75	75	70	60	50	40
2B Fisheries & Recreation	37	37	43	55	67	80	86	86	80	67	55	43
2C Fisheries & Recreation	45	45	51	63	75	87	90	90	87	75	63	51

Note:

2A Propagation and maintenance of warm or cold water (sport or commercial) fishes, aquatic recreation and bathing.

2B Propagation and maintenance of sport or commercial fishes, aquatic recreation and bathing.

2C Propagation and maintenance of locally found common fish species and recreation not requiring prolonged, intimate contact.

Missouri standards state that effluents shall not elevate or depress the average cross-sectional temperature of the stream more than 5° F., and the stream temperature shall not exceed 90° F. Missouri has set a maximum temperature of 93° F. in the Des Moines River to be consistent with the Iowa standards.

South Dakota standards designate "Fish Life Propagation--Warm Water Semi-permanent" as a use of the Big Sioux River. The stream temperature shall not exceed 90° F. and the maximum temperature change is limited to 5° F.

Nebraska does not share waters with Iowa except for the Missouri River. Nebraska standards limit the allowable change from background to 5° F. May through October and to 10° F. November through April in the Missouri River.

VI. RECOMMENDATIONS

A. Treatment and Control

1. All significant municipal wastes discharged into the interstate waters of Iowa shall receive a minimum of secondary treatment prior to discharge. All significant industrial wastes shall receive an equivalent of secondary treatment prior to discharge into any interstate stream. For the Missouri River, a timetable of compliance shall be submitted no later than December 31, 1969. In no case shall the compliance date be any later than December 31, 1977.

2. Control of bacteriological pollution by continuous disinfection shall be implemented. A timetable for implementation shall be established by September 30, 1969. In no case shall the compliance date for the installation and operation of continuous disinfection facilities extend beyond December 31, 1970.

3. For the production and well-being of locally occuring desirable stream fish populations, heat additions should be limited as follows.

At no time shall the addition of heat be authorized which will raise the water temperature more than 5° F; but in any event the addition of heat shall not raise water temperatures above a maximum tailored for each individual lake or stream and necessary to protect the production of locally occurring desirable fish populations and their associated biota.

4. On March 6, 1969, the Iowa Water Pollution Control Commission agreed to a motion supporting statements as adopted by some western States and approved by the Department of the Interior concerning the

protection of waters whose quality may exceed that of established standards.

Typical language is as follows:

> Waters whose existing quality is better than the established standards as of the date on which such standards become effective will be maintained at high quality; provided that the State has the power to authorize any project or development which would constitute a new source of pollution or an increased source of pollution to high quality water, when it has been affirmatively demonstrated that a change is justifiable to provide necessary economic or social development; provided further that the necessary degree of waste treatment to maintain high water quality will be required where physically and economically feasible. Present and anticipated use of such waters will not be precluded under the conditions aforesaid. In implementing this policy the Secretary of the Interior will be kept advised and will be provided with such information as he will need to discharge his responsibilities under the Federal Water Pollution Control Act, as amended.

The following recommendations are made in addition to the exceptions taken in the Secretary's letter of January 16, 1969, and Notice of Conference dated March 5, 1969.

5. The quality of effluents or other waste water discharged to the Missouri River and its interstate tributaries in Iowa shall be of such quality as to assure that the concentration of phenol in the receiving stream shall not exceed 1 part per billion.

6. a. Radioactive materials of other than natural origin shall not be present in any amount which shall cause the concentration of such materials to exceed the limits established in the 1962 Public Health Service Drinking Water Standards or 1/30 (168 hour value) of the values for radioactive substances specified in the National Bureau of Standards Handbook 69.

b. The annual average concentration (dissolved) of a specific radionuclide, excluding Radium—226 and Strontium—90, should not exceed 1/30 of the appropriate maximum permissible concentration for the 168-hour week given in the Report of the International Commission on Radiological Protection and the National Committee on Radiation Protection and Measurements. Limiting concentrations of Radium-226 and Strontium-90 are those set forth in the Public Health Service "Drinking Water Standards"' 3 and 10 picocurie per liter, respectively.

c. It may be necessary to limit the concentration of radioactivity in the water to a value substantially less than that permitted by the criteria of paragraph (a). It would appear likely that the average daily intake from air, food, and water of an exposed population would otherwise exceed the permissible. Because any human exposure to ionizing radiation is undesirable, the concentration of radioactivity in natural water should be maintained at the lowest practicable level.

B. Waste Treatment Schedule (Implementation Plan)

Refer to Table 11 of the Iowa Standards, dated May 1967. The words "expansion," "replacement," "additions," "new plant" should be more exactly defined. These terms in themselves are not explicit as to exactly what type of treatment is proposed. It is suggested that words be used such as: Expand present plant to include secondary treatment; Replace existing facility with new facility which includes secondary treatment; Add secondary treatment; New plant to include secondary treatment for a municipality or industry not providing any treatment at present.

VII. APPENDIX

A. Report on Baseline Survey - October 1968 and January 1969.

B. Report on Biological Investigation of Missouri River, October 1968.

C. Outdoor Recreation and Water Pollution in Western Iowa and along the Missouri River

D. Water Quality Monitoring Stations on Interstate Streams, Iowa, 1969

E. U.S. Geological Survey Temperature Stations on Interstate Streams of Iowa

F. Graphs of Surveillance Data from St. Joseph, Missouri; Omaha, Nebraska; and Yankton, South Dakota

G. Water Uses - Recognized by the State of Iowa

GLOSSARY OF TERMS

Adsorption. The adherence of dissolved, colloidal, or finely divided solids on the surfaces of solid bodies with which they are brought into contact.

Algae. Primitive plants, one or many-celled, usually aquatic and capable of elaborating their foodstuffs by photosynthesis.

Bacteria. Primitive plants, generally free of pigment, which reproduce by dividing in one, two, or three planes. They occur as single cells, groups, chains, or filaments, and do not require light for their life processes. They may be grown by special culturing out of their native habitat.

Aerobic. Bacteria which require free (elementary) oxygen for their growth.

Anaerobic. Bacteria which grow in the absence of free oxygen and derive oxygen from breaking down complex substances.

Coli-Aerogenes. See Bacteria, Coliform Group.

Coliform Group. A group of bacteria, predominantly inhabitants of the intestine of man but also found on vegetation, including all aerobic and facultative anaerobic gram-negative, non-spore-forming bacilli that ferment lactose with gas formation. This group includes five tribes of which the very great majority are Eschericheae. The Eschericheae tribe comprises three genera and ten species, of which Escherichia Coli and Aerobacter Aerogenes are dominant. The Escherichia Coli are normal inhabitants of the intestine of man and all vertebrates whereas Aerobacter

– Aerogenes normally are found on grain and plants, and only to a varying degree in the intestine of man and animals. Formerly referred to as B.Coli, B.Coli group, Coli-Aerogenes Group.

Facultative Anerobic. Bacteria which can adapt themselves to growth in the presence, as well as in the absence, of uncombined oxygen.

Parasitic. Bacteria which thrive on other living organisms.

Pathogenic. Bacteria which can cause disease.

Saprophytic. Bacteria which thrive upon dead organic matter.

Total Coliforms. "The total coliform group includes all of the aerobic and facultative anerobic, Gram-negative, nonspore-forming, rod shaped bacteria which ferment lactose with gas formation within 48 hours at 35°C." (Standards Methods, 12 ed., pg. 594)

Fecal Coliforms. The portion of the coliform groups which is present in the gut or the feces of warmblooded animals which are capable of producing gas from lactose in a suitable culture medium at 44.5°C. (Standard Methods, 12 ed., pg. 568)

Bio-Assay. A determination of the concentration of a given material by comparison with a standard preparation; on the determination of the quantity necessary to affect a test animal under stated laboratory conditions

Biochemical. Resulting from biologic growth or activity, and measured by or expressed in terms of the ensuing chemical change.

Biochemical Action. Chemical changes resulting from the metabolism of living organisms.

Biochemical Oxygen Demand (BOD). The quantity of oxygen utilized in the biochemical oxidation of organic matter in a specified time and at a specified temperature. It is not related to the oxygen requirements in chemical combustion, being determined entirely by the availability of the material as a biological food and by the amount of oxygen utilized by the microorganisms during oxidation.

Biochemical Oxygen Demand, Standard. Biochemical oxygen demand as determined under standard laboratory procedure for five days at 20°C, usually expressed in parts per million or milligrams per liter.

Chlorination. The application of chlorine for disinfection.

Break-Point. The application of chlorine to water, sewage or industrial wastes containing free ammonia to provide free residual chlorination.

Post. The application of chlorine to water, sewage, or industrial wastes subsequent to any treatment. The term refers only to a point of application.

Pre. The application of chlorine to water, sewage, or industrial wastes prior to any treatment. This term refers only to a point of application.

Coarse or Rough Fish. Those species of fish considered to be of poor fighting quality when taken on tackle and of poor food quality. These fish may be undersirable in a given situation, but at times may be classified differently, depending upon their usefulness. Examples include carp, goldfish, gar, sucker, bowfin, gizzard shad, goldeneye, mooneye, and certain kinds of catfish.

Cubic Foot per Second. A unit of discharge for measurement of flowing liquid, equal to a flow of one cubic foot per second past a given section. Also called Second-Foot.

Disinfection. A method of reducing the pathogenic or objectionable microorganisms by means of chemicals or other acceptable means.

Eutrophication. The intentional or unintentional enrichment of water.

Eutrophic Waters. Waters with a good supply of nutrients. There waters may support rich organic productions, such as algal blooms.

Effluent. (1) A liquid which flows out of a containing space. (2) Sewage, water, or other liquid, partially or completely treated, or in its natural state, as the case may be, flowing out of a reservoir, basin, or treatment plant, or part thereof.

Final. The effluent from the final unit of a sewage treatment plant.

Stable. A treated sewage which contains enough oxygen to satisfy its oxygen demand.

Game Fish. Those species of fish considered to possess sporting qualities on fishing tackle. These fish may be classified as undesirable, depending upon their usefulness. Examples of fresh water game fish are salmon, trout, grayling, black bass, muskellunge, walleye, northern pike, and lake trout.

Grease. In sewage, grease including fats, waxes, free fatty acids, calcium and magnesium soaps, mineral oils, and other non-fatty materials. The type of solvent used for its extraction should be stated.

Influent. Sewage, water, or other liquid, raw or partly treated, flowing into a reservoir, basin, or treatment plant, or part thereof.

Membrane Filter (MF) - A technique of bacteriological analysis. This technique involves the running of a certain volume of water through a cellulose ester wafer which is then impregnated with growth media for bacteria.

Milligrams per Liter (mg/l) - Milligrams of solute per liter of solution. Equivalent to parts per million assuming unit density.

Microgram per Liter = 0.001 Milligrams per Liter

"Most Probable Number" (MPN) - A test of bacterial density expressed as a number of organisms per hundred milliliters. It is a number most likely to occur, using statistical methods, under the given circumstances or conditions of the test.

Oxygen. A chemical element.

Available. The quantity of uncombined or free oxygen dissolved in the water of a stream.

Balance. The relation between the biochemical oxygen demand of a sewage or treatment plant effluent and the oxygen available in the diluting water.

Consumed. The quantity of oxygen taken from potassium permanganate in solution by a liquid containing organic matter. Commonly regarded as an index of the carbonaceous matter present.

Time and temperature must be specified. The chemical oxygen demand (COD) uses potassium dichromate.

Deficiency. The additional quantity of oxygen required to satisfy the biochemical oxygen demand in a given liquid. Usually expressed in parts per million.

Dissolved. Usually designated as DO. The oxygen dissolved in sewage, water or other liquid usually expressed in parts per million or percent of saturation.

Residual. The dissolved oxygen content of a stream after deoxygenation has begun.

Sag. A curve that represents the profile of dissolved oxygen content along the course of a stream, resulting from deoxygenation associated with biochemical oxidation of organic matter, and reoxygenation through the absorption of atmospheric oxygen and through biological photosynthesis.

Parts Per Million. Milligrams per liter expressing the concentration of a specified component in a dilute sewage. A ratio of pounds per million pounds, grams per million grams, etc.

Pollution. The addition of sewage, industrial wastes, or other harmful or objectionable material to water.

pH. The logarithm of the reciprocal of the hydrogen-ion concentration. The pH value indicates the relative intensity of acidity or alkalinity of water with the neutral point at 7.0.

Population Equivalent. (1) The calculated population which would normally contribute the same amount of biochemical oxygen demand (BOD) per day. A common base is 0.167 lb. of 5-day BOD per capita per day. (2) For an industrial waste, the estimated number of people contributing sewage equal in strength to a unit volume of the waste or to some other unit involved in producing or manufacturing a particular commodity.

Purification. The removal, by natural or artificial methods, or objectionable matter from water.

Sewage. Largely the water supply of a community after it has been fouled by various uses. From the standpoint of source it may be a combination of the liquid or water-carried wastes from residences, business buildings, and institutions, together with those from industrial establishments, and with such ground water, surface water, and storm water as may be present.

Domestic. Sewage derived principally from dwellings, business buildings, institutions, and the like. (It may or may not contain ground water, surface water, or storm water.)

Fresh. Sewage of recent origin containing dissolved oxygen at the point of examination.

Industrial. Sewage in which industrial wastes predominate.

Stable. Sewage in which the organic matter has been stabilized.

Raw. Sewage prior to receiving any treatment.

Sanitary. (1) Domestic sewage with storm and surface water excluded. (2) Sewage discharging from the sanitary conveniences of dwellings (including apartment houses and hotels), office buildings, factories, or institutions. (3) The water supply of a community after it has been used and discharged into a sewer.

Septic. Sewage undergoing putrefaction under anaerobic conditions.

Settled. Sewage from which most of the settleable solids have been removed by sedimentation.

Stale. A sewage containing little or no oxygen, but as yet free from putrefaction.

Treatment. Any definite process for modifying the state of matter.

Preliminary. The conditioning of an industrial waste at its source prior to discharge, to remove or to neutralize substances injurious to sewers and treatment processes or to effect a partial reduction in load on the treatment process. In the treatment process, unit operations which prepare the liquor for subsequent major operations.

PRIMARY TREATMENT

By this treatment most of the settleable solids or about 40 to 60 percent of the suspended solids are separated or removed from the sewage by the physical process of sedimentation in settling tanks. When certain chemicals are used with primary tanks much of the colloidal as well as the settleable solids or a total of 80 to 90 percent of the suspended solids are removed. Biological activity in the sewage is of negligible importance to the process.

SECONDARY TREATMENT

Secondary treatment depends primarily upon biological aerobic organisms for the biochemical decomposition of organic solids to inorganic or stable organic solids. It is comparable to the zone of recovery in the self-purification of a stream.

The devices used in secondary treatment may be divided into four groups.

(1) Trickling filters with secondary settling tanks

(2) Aeration tanks--(a) activated sludge with final settling tanks, and, (b) contact aeration

(3) Intermittent sand filters

(4) Stabilization ponds

CHLORINATION

This is a method of treatment which may be employed for many purposes in all stages in sewage treatment, and even prior to preliminary treatment. It involves the application of chlorine to the sewage for the following purposes.

(1) Disinfection or destruction of pathogenic organisms

(2) Prevention of sewage decomposition--(a) odor control, (b) protection of plant structures

(3) Aid in plant operation--(a) sedimentation, (b) trickling filters, (c) activated sludge bulking

(4) Reduction or delay of biochemical oxygen demand

Water, Potable. Water which does not contain objectionable pollution, contamination, minerals, or infection agents, and is considered satisfactory for domestic consumption.

Warm and Cold-Water Fish. Warm-water fish include black bass, sunfish, catfish, gar, and others; whereas cold-water fish include salmon and trout, whitefish, miller's thumb, and blackfish. The temperature factor determining distribution is set by adaptation of the eggs to warm or cold water.

x

APPENDIX A

PHYSICAL, CHEMICAL AND BACTERIOLOGICAL WATER QUALITY of the MISSOURI RIVER

October 1968

and

January 1969

Prepared by

POLLUTION EVALUATION SECTION
TECHNICAL ADVISORY & INVESTIGATIONS BRANCH
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
Cincinnati, Ohio

SUMMARY

1. This report covers the 360-mile reach of the Missouri River from Gavins Point Dam near Yankton, South Dakota, to St. Joseph, Missouri

2. Two surveys were conducted in this reach. The first occurred from October 7 to October 18, 1968; the second from January 20 to January 31, 1969.

3. Thirty-seven separate chemical, biochemical, and bacteriological examinations were made on the various samples from twenty-eight locations for the October 1968 survey and fourteen sampling locations for the January 1969 survey. Main stem, tributary and waste source stations were included in the surveys.

4. Three hydrologic conditions were encountered during the two surveys:

   a. Normal fall weather and navigation flows for the first eight sampling days of the October 7-18, 1968 survey with stream temperatures ranging from 14°C. to 16°C. and flows of 36,650 cfs at St. Joseph, Missouri.

   b. Two days of a general, intense rainfall causing nearly double normal navigation flows in the St. Joseph, Missouri, part of the study reach for these last two days of the October 7-18, 1968 survey with stream temperatures decreasing to 10°C. to 16°C. and flows increasing to 70,450 cfs at St. Joseph, Missouri.

c. Winter weather and normal non-navigation flows with stages affected by ice jams occurring for the January 20-31, 1969 survey with stream temperatures ranging from -0.4°C. to 1.6°C. and flows at 19,920 cfs at St. Joseph, Missouri.

5. Dissolved oxygen concentrations were equal to, or exceeded, 8.3 mg/l at all main stem Missouri River stations during the 8-day normal weather period of the October 1968 survey. The lowest average dissolved oxygen concentrations for the 2-day rain-affected period was 5.2 mg/l upstream from St. Joseph, Missouri. Dissolved oxygen concentrations exceed 9.0 mg/l at all main stem stations during the January 1969 survey.

6. For the 8-day normal weather period in the October 1968 survey:

a. The highest geometric mean coliform densities downstream from Sioux City, Iowa were 62,800 MPN/100 ml total coliforms and 26,600 MPN/100 ml fecal coliforms. Downstream from Omaha, Nebraska-Council Bluffs, Iowa, the highest geometric mean densities were 256,000 MPN/100 ml total coliforms and 61,200 MPN/100 ml fecal coliforms.

b. For the 2-day rain-affected period in October 1968, both total and fecal coliforms exceeded 100,000 MPN/100 ml at 19 of the 21 river stations. The highest 2-day densities were 1,440,000 MPN/100 ml total coliforms and 1,120,000 MPN/100 ml fecal coliforms.

c. For the January 1969 survey, coliform densities were much lower than those observed during the 8-day normal period in October 1968. Downstream from Sioux City, Iowa, densities were 45,000 MPN/100 ml total coliforms and 11,000 MPN/100 ml fecal coliforms. Downstream from Omaha-Council Bluffs, densities were 54,000 MPN/100 ml total coliforms and 14,000 MPN/100 ml fecal coliforms.

7. Total suspended solids for the 8-day normal period in October 1968 increased from 45 mg/l at Gavins Point Dam to the highest average concentration of 278 mg/l. Fourteen of the twenty main stem stations averaged over 700 mg/l during the 2-day rain-affected period in the October 1968 survey. The highest concentration during this period was 2,780 mg/l. Total suspended solids concentrations were greatly reduced during the January 1969 survey, when concentrations ranged between 48 mg/l and 2 mg/l.

8. Total phosphorus (as P) concentrations for the 8-day normal period in October 1968 increased from 0.04 mg/l in releases from Gavins Point Dam to 0.30 mg/l downstream from Omaha-Council Bluffs. Concentrations increased during the rain-affected period in October. Average concentrations reached 0.92 mg/l upstream from St Joseph, Missouri.

9. Total Nitrogen (ammonia, nitrate and total organic nitrogen; all as N) ranged from 0.7 mg/l to 2.9 mg/l during the normal weather period. The highest concentration for the rain-affected period was 4.1 mg/l.

10. Cyanide concentrations ranged from less than 1.0 to 6.2 µg/l in the samples from six of seven stations selected for analysis in October 1968 and all five stations selected for the January 1969 survey. During the October 1968 rain-affected period, concentrations exceeded 10 µg/l at four of the seven stations and reached a maximum of 15.2 µg/l downstream from Sioux City, Iowa.

EXISTING WATER QUALITY

Survey Description

Survey Periods

Two stream surveys were conducted to determine the present day (1968-69) Missouri River water quality along the 700-mile reach from Gavins Point Dam near Yankton, South Dakota, to Hermann, Missouri.

The first survey was conducted during the high flow navigation season when the river discharge was regulated to maintain navigation channel depths. This survey was conducted in two phases. The upper reach, extending from Gavins Point Dam to St. Joseph, Missouri, was sampled from October 7 to October 18, 1968. The lower reach, extending from St. Joseph to Hermann, Missouri, was sampled from October 28 to November 8, 1968.

The entire 700-mile reach was sampled in a single phase during the second survey. Sampling was conducted from January 20 to January 31, 1969, to determine water quality during the winter, low flow, non-navigation season.

Station Locations

The coverage included in this report will be limited to the reach from Gavins Point Dam to St. Joseph, Missouri (Figure A-1). Sampling periods of interest are the October 7-18, 1968 period and the January 20-31, 1969 period. This river reach encompasses the Iowa borders along the Missouri River and includes parts of the borders of South Dakota, Nebraska, Missouri, and Kansas.

Planning of the two surveys was designed to give more extensive river coverage during the October survey when the river was readily accessible, and when sampling could be accomplished from boats. The January survey was designed to re-examine water quality near urban areas with less extensive coverage at intervening, less accessible areas. Because of reduced flows and ice in the river, sampling during the January survey was conducted from automobiles.

Twenty-eight sampling stations were selected in the Gavins Point Dam to St. Joseph, Missouri, river reach for the October 1968 survey (Figure A-1 and Table A-7). Twenty stations were located on the main stem of the Missouri River, five stations were on tributary streams, and three stations were waste sources.

Fourteen sampling stations were used in this same reach during the reduced January 1969 survey (Figure A-1 and Table A-7). Ten stations were on the main stem at, or near, the earlier survey stations, two stations were on tributary streams, and three stations were waste sources.

Stations sampled during the January 1969 survey were located as closely as possible to the October 1968 locations. Where locations were not identical, a letter symbol was added to the station number to distinguish this difference.

Analyses

Many analyses were necessary to determine the existing, present day water quality in the Missouri River. Excluding biological examinations (covered separately), 37 separate chemical, biochemical, and bacteriological constituents were included in the laboratory analysis series. Some analyses were performed on daily discrete samples from each station. Five-day composite samples were made and preserved for analysis of other constituents at selected stations. Sample compositing was used to keep the required number of analyses within manageable limits. Unfortunately, several analyses on preserved and/or composited samples from the January 1969 survey were not completed in time for inclusion in this report.

Analyses performed daily were done in mobile laboratories. Two mobile laboratories were located at the Florence Pumping Station of the Omaha, Nebraska, Metropolitan Utilities District Water Plant. These two laboratories performed all field analyses for the Gavins Point Dam - St. Joseph, Missouri, reach during the October 1968 survey and all but the two lower stations in this same reach during the January 1969 survey The lower two stations were handled by laboratories of the FWPCA Missouri Basin Region in Kansas City, Missouri.

Analyses performed daily at every station in the reach included:

1. Dissolved Oxygen (D.O.).
2. 2- and 5-day Biochemical Oxygen Demand (BOD).
3. pH.
4. Alkalinity.
5. Specific Conductance.
6. Turbidity.
7. Total and Fecal Coliforms.
8. Fecal Streptococci (January only).
9. Chlorides (3 times per week in October).
10. Sulfates (3 times per week in October).
11. Total Dissolved Solids (3 times per week in October).
12. Total Suspended Solids (3 times per week in October).

Weekly composites from five samples were made and preserved for every station in the reach for the following determinations:

1. Calcium.
2. Magnesium.
3. Organic Carbon.
4. Total Phosphorus.
5. Nitrogen Series (ammonia, nitrates and total organic nitrogen).

For the study reach, nine stations for the October 1968 survey and four of these stations for the reduced January 1969 survey were selected for the following determinations:

1. Sodium.
2. Potassium.
3. Fluoride.
4. Boron.

Samples were also filtered with the filtrate being composited for determination of soluble heavy metals. Eight stations were selected for the October 1968 survey, with six of these also being sampled during the reduced January 1969 survey. Metal analyses were:

1. Arsenic.
2. Iron.
3. Barium.
4. Manganese.
5. Cadmium.
6. Chromium.
7. Copper.
8. Lead.
9. Nickel.
10. Zinc.

Samples at selected stations were collected for phenol analysis on two occasions during the October 1968 survey and on four occasions during the January 1969 survey. Samples for cyanide analysis were collected on four occasions during each survey. Seven stations were selected for these analyses during the October 1968 survey with five of these stations being repeated during the January 1969 survey.

Separate samples for organic chlorine analysis and for a chloroform extract analysis were collected at the same six stations during both the October 1968 and January 1969 surveys.

Long-term (20-day) biochemical oxygen demands (BOD) were run twice at eight stations during the October 1968 survey, and once at five of these same stations during the January 1969 survey.

Five-day composite samples from waste source stations for each sampling week were analyzed for grease content. This analysis was in addition to the other analyses performed on the samples. Samples from the Monroe Street and South Omaha sewers containing the meat-packing wastes from Omaha, Nebraska, and the effluent from the Sioux City, Iowa, sewage treatment plant were collected during the October 1968 survey. Effluent samples from the Omaha, Nebraska-Missouri River sewage treatment plant, Council Bluffs, Iowa sewage treatment plant, and the Sioux City, Iowa sewage treatment plant were collected during the January 1969 survey.

Five-day composites for radioactivity analysis were made at two main stem stations and at four tributary stations during the October 1968 survey. Only results for uranium (U-235 and U-238) and radium-226 are available Thorium-232 and strontium-90 analyses are still in progress.

Analytical Methods

All chemical analyses conformed to "FWPCA Official Interim

Methods for Chemical Analysis of Surface Waters."(1) Except for modifications required for automated chemistry, methods contained in this volume are essentially the same as those contained in the 12th Edition of "Standard Methods for the Examination of Water and Wastewater."(2) Most metals were analyzed by atomic absorption spectroscopy.

Bacterial examinations were performed in accordance with Standard Methods. In this report, the term, "total coliforms," refers to bacteria identified as the "Coliform Group" in Standard Methods. "Fecal coliforms" refer to the "Section I Coliform Group" in Standard Methods.

Total and fecal coliforms were enumerated by the multiple tube, fermentation test which yields a density as a most probable number (MPN). Bacterial densities are reported as a number per 100 milliliters (ml) of water.

Survey Results

Missouri River and Tributary Flows

Water released from Gavins Point Dam is the major controlling factor affecting Missouri River flows during dry weather conditions in the Gavins Point Dam - St. Joseph, Missouri river reach. During periods of heavy rainfall the hydrology of tributary streams greatly affects discharges in the main stem Missouri River. Ice jams in the river during cold, winter weather can also interfere with normal stages and discharge rates.

---

(1) Anon., "FWPCA Official Interim Methods for Chemical Analysis of Surface Waters," Federal Water Pollution Control Administration, September 1968.

(2) Anon., "Standard Methods for the Examination of Water and Wastewater," 12th Edition, APHA, 1965.

For the period October 7-16, 1968, which included the first 8 sampling days, river discharges reflected normal weather conditions with an average of 31,200 cubic feet per second (cfs) being released from Gavins Point Dam (Table A-1). Tributary inflows increased the flow to an average of 36,650 cfs at St. Joseph, Missouri, 360 miles downstream. Rainfall for this period was recorded as 0.46 inches in Omaha, Nebraska. This time period will be referred to as the "8-day average" in figures, tables and text of this report.

Beginning October 16, 1968 a general, heavy rainfall occurred in the basin. During the period of October 16-17, 1968, Sioux City, Iowa, recorded 4.63 inches of rain; Omaha, Nebraska recorded 3.61 inches and St. Joseph, Missouri, recorded 1.32 inches. Average water released from Gavins Point Dam of 28,500 cfs for the period October 17-18, 1968 was slightly less than the average of the 10 previous days, being only 91 percent of the earlier flows. However, flows increased to 105 percent of the earlier period flows, or 34,050 cfs, at Sioux City, Iowa; increased to 139 percent, or 45,900 cfs at Omaha, Nebraska; and increased to 192 percent or 70,450 cfs at St. Joseph, Missouri, (Table A-1). The ratio of rain-affected flows to dry weather flows increased in the downstream direction. This period will be referred to as the "2-day average" in figures, tables and text of this report.

Tributary streams exhibited even greater percentage flow increases between the normal weather period and the rain-affected period. The Big Sioux River increased to 415 percent of the 8-day period

(169 cfs vs 701 cfs); the Boyer River increased to 563 percent (270 cfs vs 17,100 cfs). The October 1968 survey, therefore, reflects two distinctly different river conditions. Samples from the October 7-16, 1968 period reflect river conditions during "normal" weather; samples from the October 17-18, 1968 period reflect river conditions warped by extremely heavy rains.

Flows during the January 1969 study were affected by ice jams in the river. For much of the survey period, river stages were higher than normal summer navigation levels upstream from St. Joseph, Missouri. Flow rates were also affected by the damming effect of the ice jams. Flows at Omaha, Nebraska, averaged about 1,800 cfs (16,925 cfs to 15,080 cfs) less than that released from Gavins Point Dam (Table A-1). Flow at St. Joseph, Missouri, downstream from the ice jams averaged 19,920 cfs.

Dissolved Oxygen

For the first 8 sampling days in the October 1968 survey, average dissolved oxygen (D.O.) concentrations were 8.3 mg/l or greater in the main stem Missouri River (Figure A-2 and Table A-2). The highest average D.O. concentration was 9.5 mg/l and occurred at Station M-52 (RM-736) upstream from Sioux City, Iowa.

Downstream from Station M-52, significant quantities of wastes were discharged from the Sioux City area. D.O. concentrations decreased slightly in the reach from Sioux City, Iowa to Omaha, Nebraska. The average D.O. concentration at the Omaha, Nebraska, Metropolitan Utilities District (M.U.D.) water works intake at Station M-42 (RM-626.2) was 9.1 mg/l. Downstream from the water works, wastes from Omaha, Nebraska-Council Bluffs, Iowa enter the Missouri River. D.O. concentrations decreased to 8.4 mg/l approximately one day's time-of-water travel downstream at Station M-36 (RM-591.2). D.O. concentrations improved slightly during the remainder of reach averaging 8.6 mg/l at M-28 (RM-452.3) at the St. Joseph Water Company intake.

The rain-affected 2-day average D.O. concentrations generally decreased from Sioux City, Iowa to St. Joseph, Missouri (Figure A-2). D.O. concentrations varied inversely with river flows; as the ratio of wet weather flows to dry weather flows increased, D.O. concentrations tended to decrease.

Two-day average D.O. concentrations of 10.0 mg/l at Station M-52, 9.7 mg/l at Station M-50, and 9.4 mg/l at Station M-48 were greater than corresponding 8-day averages. Two-day and 8-day average D.O. concentrations were both 9.2 mg/l at Station M-47 near Whiting, Iowa.

Downstream from Whiting, Iowa, 2-day average D.O. concentrations were less than corresponding 8-day averages. Two-day averages decreased from 9.0 mg/l at Station M-46 (RM-676.5) to 8.0 mg/l at Station M-44 (RM-654.6) with the Little Sioux and Soldier Rivers entering between these two stations.

Two-day average D.O. concentrations were 8.0 mg/l at Station M-42 (RM-626.2) at the Omaha, M.U.D. water intake. A further D.O. concentration decrease to 7.6 mg/l at Station M-38 (RM-601.3) near Bellevue, Nebraska, was observed followed by a slight increase to 7.8 mg/l at Station M-36 (RM-571.2) downstream from the Platte River. D.O. concentrations downstream had a downward trend until the lowest two-day average of 5.2 mg/l occurred at Station M-29 (RM-469.0) upstream from St. Joseph, Missouri. The two-day average at the St. Joseph Water Company intake was 5.6 mg/l.

January 1969 survey results show the effects of an ice cover which extended from a point upstream from St. Joseph to upstream from Omaha, Nebraska, during the second week of the survey. Upstream from the ice cover D.O. concentrations exceeded 12.5 mg/l with a concentration of 13.2 mg/l occurring at Station M-42 (RM-626.2) at the Omaha M.U.D. water works intake.

With the introduction of wastes from the Omaha-Council Bluffs area and the ice cover eliminating reaeration, D.O. concentrations decreased steadily to the lowest average of 9.1 mg/l at Station M-30 (RM-488.3) near White Cloud, Kansas (Figure A-2). Downstream from the ice jam, the D.O. concentration increased to 9.6 mg/l at the St. Joseph water works intake (RM-452.3).

5-Day, 20°C. Biochemical Oxygen Demand (BOD_5)

The BOD_5 for the 8-day normal weather period in October 1968 reflected the waste discharges from the Sioux City, Iowa and the Omaha, Nebraska-Council Bluffs, Iowa metropolitan areas (Figure A-3 and Table A-2).

From background concentrations of 0.9 mg/l at Station M-52 (RM-736.0) upstream from Sioux City, the BOD_5 was increased to 1.6 mg/l at Station M-47 (RM-699.5) by waste from the Sioux City area.

The BOD_5 concentration was 1.9 mg/l at Station M-42 (RM-626.2) at the Omaha M.U.D. water intake. Downstream waste discharges from the Omaha-Council Bluffs area increased the BOD_5 to 5.8 mg/l at Station M-39 (RM-610.5).

The average BOD_5 concentrations for the 2-day rain-affected period increased substantially throughout the entire survey reach. In addition to waste being added from the Sioux City and the Omaha-Council Bluffs areas, significant BOD_5 loads from tributary streams, including the Little Sioux River, Soldier River and Boyer River are evident (Figure A-3). For example, the 2-day average for BOD_5 was three times the dry weather concentration (6.9 mg/l vs 2.3 mg/l) in the Soldier River and increased from 9.2 mg/l to 14.0 mg/l in the Boyer River.

The January 1969 survey data indicate concentration increases similar to the 8-day average of the October 1968 survey. BOD_5 concentrations in the Sioux City area increased from 1.1 mg/l at Station M-52A (RM-732.8) to 2.0 mg/l at Station M-47 (RM-699.5). The increase in Omaha was from a BOD_5 of 1.4 mg/l at Station M-42 (RM-626.2) to 3.6 mg/l at Station M-38 (RM-601.3).

Coliform Bacteria

Water released from Gavins Point Dam contained low densities of coliform bacteria during the October 1968 and January 1969 surveys (Table A-4 and Figures A-4 and A-5). Total coliforms occurred at mean(1) densities of 250 MPN/100 ml and fecal coliforms at less than 120 MPN/100 ml during the October 1968 survey. There were less than 30 MPN/100 ml total coliforms and less than 20 MPN/100 ml fecal coliforms during the January 1969 survey.

Mean coliform densities for the 8-day normal weather October 1968 period at Station M-52 (RM-736.0) were 1,380 MPN/100 ml total coliforms and 220 MPN/100 ml fecal coliforms. Wastes from the Sioux City, Iowa, area increased total coliforms to 62,800 MPN/100 ml and fecal coliforms to 14,300 MPN/100 ml of Station M-48 (RM-717.4). An increase in fecal coliforms density to 26,600 MPN/100 ml occurred at Station M-47 (RM-699.5).

---

(1) In discussion of coliforms and fecal coliforms, mean refers to geometric mean throughout this report section.

A major cause of this increase in bacterial densities was the unchlorinated discharge from the Sioux City, Iowa, sewage treatment plant. Eight-day average mean densities in this waste discharge were 75,000,000 MPN/100 ml total coliforms and 20,000,000 MPN/100 ml fecal coliforms.

Coliform densities at the Omaha M.U.D. water intake (Station M-42, RM-626.2) were less than those at Station M-47 (RM-717.4) even though the Boyer River contributed mean densities of 110,000 MPN/100 ml total coliforms and 15,000 MPN/100 ml fecal coliforms. Eight-day normal weather mean densities at Station M-42 were 52,300 MPN/100 ml total coliforms and 8,300 MPN/100 ml fecal coliforms.

Wastes from Omaha, Nebraska-Council Bluffs, Iowa increased mean coliform densities at Station M-39 (RM-610.5) to 256,000 MPN/100 ml total coliforms and 61,200 MPN/100 ml fecal coliforms. The major cause of this increase was unchlorinated wates from Omaha, Nebraska and Council Bluffs, Iowa.

Downstream from Omaha, Nebraska-Council Bluffs, Iowa, a decreasing pattern in coliform densities occurred. At the St. Joseph, Missouri, Water Company intake, densities had decreased to 57,700 MPN/100 ml total coliforms and 6,500 MPN/100 ml fecal coliforms.

During the 2-day rain-affected period, coliform bacteria increased to very high densities throughout the entire reach. Nineteen of the twenty-one sampling stations had both total fecal coliform densities that exceeded 100,000 MPN/100 ml. The highest densities were at Station M-34 (RM-559.7) where densities were 1,440,000 MPN/100 ml total coliforms and 1,120,000 MPN/100 ml fecal coliforms.

Tributary streams also exhibited increases to very high densities during the 2-day wet-weather period. The Soldier River had mean densities of 2,400,000 MPN/100 ml total coliforms and 2,000,000 MPN/100 ml fecal coliforms. The Boyer River had densities of 2,000,000 MPN/100 ml total coliforms and 1,400,000 MPN/100 ml fecal coliforms. The Platte River also increased to densities of 620,000 MPN/100 ml total coliforms and 290,000 MPN/100 ml fecal coliforms. Much of the increases observed during this wet period is due to runoff from the large number of feedlots in the basin.

Coliform bacteria densities for the January 1969 survey were less than the 8-day normal-weather period in October 1968. Total coliform densities at Station M-48A, for example, were 45,000 MPN/100 ml which is 72 percent of the October 1968 density; fecal coliforms were 11,000 MPN/100 ml which is 77 percent of the October 1968 density. Downstream at the Omaha M.U.D. water intake (Station M-42, RM-626.2), total coliform densities were approximately 6,000 MPN/100 ml which is 11 percent of the October 1968 survey; fecal coliforms were 4,900 MPN/100 ml which is 59 percent of the October 1968 densities.

The decrease in the January 1969 densities within the Sioux City-Omaha reach is caused principally by the reduced densities in the waste flows from the Sioux City Sewage Treatment Plant between the

January 1969 and October 1968 surveys (Total coliforms: 19,000,000 MPN/100 ml vs 75,000,000 MPN/100 ml; fecal coliforms: 5,200,000 MPN/100 ml vs 20,000,000 MPN/100 ml).

A pattern similar to the reach downstream from Sioux City, Iowa occurred downstream from Omaha, Nebraska. For example, the January 1969 total coliform density at Station M-38 (RM-601.3) was 54,000 MPN/100 ml which was 33 percent of the October 1968 density. Similarly the January 1969 fecal coliform density was 14,000 MPN/100 ml which was 31 percent of the October 1968 density.

Total Suspended Solids

The total suspended solids concentration for the October 1968 survey for water released from Gavins Point Dam (RM-811.0) averaged 45 mg/l (Table A-2 and Figure A-6). Data at this station were not separated into "normal" and "wet-weather" periods since the rain did not affect water quality at this station.

For the normal weather 8-day period, the total suspended solids increased to 55 mg/l downstream from the dam at Station M-52 (RM-736.0). The concentration remained relatively uniform at this level for 60 miles downstream to Station M-46 (RM-676.5).

Downstream from Station M-46 (RM-676.5), the total suspended solids increased until the highest average concentration of 278 mg/l occurred at Station M-32 (RM-525.1). The total suspended solids decreased downstream from Station M-32 to a concentration of 142 mg/l at Station M-31 (RM-507.5). The concentration averaged 131 mg/l at the St. Joseph Water Company intake at Station M-28 (RM-452.3).

The rain-affected two-day average total suspended solids concentrations were several times greater than the 8-day normal weather concentrations. Upstream from the Soldier River, which includes stations M-52 (RM-736.0) to M-46 (RM-676.5), total suspended solids concentrations ranged from 87 mg/ at Station M-50 (RM-730) to 147 mg/l at Station M-48. Total suspended solids increased to 3,530 mg/l in the Soldier River (S-45, RM-664.0) which contributed to an increase to 715 mg/l in the Missouri River at Station M-44 (RM-654.6).

Total suspended solids concentrations followed an irregular, although generally upward trend for the remaining stations in the reach during the two-day rain-affected period. Downstream from and including the Omaha M.U.D. water intake (Station M-42, RM-626.2), all of the remaining 13 main stem stations exceeded 700 mg/l total suspended solids, 10 stations exceeded 1,000 mg/l and two stations exceeded 2,000 mg/l. The highest average for the 2-day period was 2,784 mg/l at the St. Joseph Water Company intake (Station M-28, RM-452.3).

Total suspended solids concentrations during the January 1969 survey were quite low when compared with results from the October 1968 survey. The highest average concentration was 48 mg/l at Station M-52A (RM-732.8) upstream from Sioux City, Iowa. The nine remaining main stem stations downstream from Sioux City had concentrations between 9 and 28 mg/l. The water released from Gavins Point Dam (RM-811.0) contained only 2 mg/l total suspended solids concentrations.

The clarity of the Missouri River in January 1969, as compared with October 1968, is attributed to the frozen condition of the drainage basin. Tributary runoff carrying clay and silt particles was small.

The damming effect of the ice jams reduced water velocity, which allowed sedimentation and contributed to water clarity.

Nitrogen and Phosphorus

Total nitrogen, which consists of ammonia, nitrates and total organic nitrogen forms, and total phosphorus were determined for two separate 5-day composites for all stations within the survey reach. Results for the first composite were collected during normal weather conditions while the second composite included the rain-affected period (Figures A-7 and A-8).

Phosphorus

Average total phosphorus concentrations were 0.04 mg/l in water released from Gavins Point Dam (RM-811.0) during the October 1968 survey. Concentrations during the 8-day normal weather period increased to 0.07 mg/l at Station M-48 (RM-717.4) downstream from the Sioux City, Iowa, area. Total phosphorus concentrations generally increased downstream and were 0.12 mg/l at the Omaha M.U.D. water intake (Station M-42, RM-626.2).

Downstream from the Omaha-Council Bluffs area, the total phosphorus increased to 0.24 mg/l at Station M-39 (RM-610.5) during the normal weather period. The concentration again increased to 0.30 mg/l at Station M-36 (RM-591.2) downstream from Papillion Creek and the Platte River. The total phosphorus concentration remained essentially unchanged during the remainder of the reach. The concentration at the St. Joseph Water Company intake (Station M-28, RM-452.3) was 0.26 mg/l.

Total phosphorus concentrations increased greatly in the rain-affected composite samples reflecting the agricultural land use of the drainage basin. For example, concentrations in the Soldier

River increased from 0.17 mg/l to 3.00 mg/l. Total phosphorus concentrations increased irregularly downstream from Gavins Point Dam reaching the highest average concentration of 0.92 mg/l at Station M-29 (RM-469.0).

Nitrogen

Normal weather total nitrogen concentration increased from 0.7 mg/l at Gavins Point Dam (RM-811.0) to 1.5 mg/l at Station M-52 (RM-736.0) upstream from Sioux City. A general decreasing trend in total nitrogen concentration occurred downstream from Sioux City to a concentration of 1.1 mg/l at Station M-44 (RM-654.6). Total nitrogen concentrations increased downstream from the Boyer River, which had a concentration of 9.34 mg/l (Station B-43, RM-635.1), to 1.3 mg/l at the Omaha M.U.D. water intake (Station M-42, RM-626.2). Concentrations exhibited a generally increasing trend downstream from the Platte River reaching a concentration of 2.3 mg/l at Station M-32 (RM-525.1). The highest concentration in the reach occurred at the St. Joseph Water Company intake (Station M-28, RM-452.3) and was 2.9 mg/l.

The rain-affected composite samples had an irregular trend although generally increasing downstream. Concentrations were less than the normal-weather data for the Gavins Point Dam (RM-811.0) to Sioux City, Iowa, reach; approximately the same from Sioux City to the Soldier River (RM-664.0); and greater than the normal-weather concentrations downstream from the Soldier River. The highest total nitrogen concentration was 4.1 mg/l at Station M-29 (RM-469.0). Five of the main stem stations had total nitrogen concentrations of 3.0 mg/l or greater.

Nitrogen and phosphorus analyses are not presently available for the January 1969 survey.

Cyanide

Positive cyanide results were obtained for samples from six of seven stations selected for analysis in October 1968 and all five stations selected for the January 1969 survey (Table A-5). Average concentrations which indicate a "less than (<)" average had at least one analysis less than 1 microgram per liter (µg/l), which is the sensitivity of the analysis method.

The highest single result of 15.2 µg/l occurred during the October 1968 rain-affected period at Station M-33 (RM-546.7). Four of the seven stations had concentrations greater than 10 µg/l. The highest average concentration during the October 1968 survey was 6.2 µg/l at Station M-48 (RM-717.4) downstream from Sioux City, Iowa.

The highest average cyanide concentration during the January 1969 survey was < 3.6 µg/l at the Omaha M.U.D. water intake (Station M-42, RM-626.2).

Water Temperature

Average water temperatures during the 8-day normal period ranged from 16°C. at the St. Joseph Water Company intake to 14°C. at Station M-52 (RM-736.0) upstream from Sioux City, Iowa (Table A-2). Average temperatures decreased during the two-day rain-affected period in the upper reaches. Temperatures remained unchanged at Station M-28 at 16°C. but decreased to 10°C. at Station M-52.

Average water temperature during the January 1969 survey ranged from 1.6°C. at the St. Joseph Water Company intake to -0.4°C. at Station 52 upstream from Sioux City.

pH

The pH of Missouri River water was about 8.3 for most stations during the October 1968 normal-weather period (Table A-5). The highest average was 8.6 at Station M-38 (RM-601.3). The lowest average was 8.1 at Station M-35 (RM-580.9).

The pH decreased slightly at several stations during the 2-day rain-affected period. The lowest average pH during this period in the main stem Missouri River was 7.8 at Station M-30 (RM-488.3).

The average pH was lower during the January 1969 survey than the 8-day normal period in October 1968. The pH ranged from 7.8 at the St. Joseph Water Company intake (M-28, RM-452.3) to 8.1 at Station M-52 (RM-736.0) upstream from Sioux City, Iowa.

Alkalinity

The October 1968 survey normal-weather 8-day average alkalinity (Table A-2) of the Missouri River ranged from a low of 160 mg/l (as $CaCO_3$) at Station M-46 (RM-676.5) to the highest average of 197 mg/l (as $CaCO_3$) at Station M-44 (RM-654.6). The 2-day rain-affected period averages ranged from 114 mg/l (as $CaCO_3$) at Station M-39 (RM-610.5) to 180 mg/l (as $CaCO_3$) at Station M-35 (RM-580.9). Rainfall reduced alkalinity slightly.

Alkalinities during the January 1969 survey were approximately the same. Concentrations ranged from 165 mg/l (as $CaCO_3$) at Station M-30 (RM-488.3) to 191 mg/l (as $CaCO_3$) at the Omaha M.U.D. water intake (M-42, RM-626.2).

Total Dissolved Solids

The total dissolved solids (Table A-2) of the water released from Gavins Point Dam averaged 474 mg/l during the October 1968 survey. Averages for the 8-day normal-weather period for the remainder of the reach ranged between a high of 645 mg/l at Station M-32 (RM-525.1) to 468 mg/l at Station M-29 (RM-469.0). Nineteen of the 20 stations averaged less than 552 mg/l.

Total dissolved solids concentrations were higher during the January 1969 survey than during October 1968. The water released from Gavins Point Dam (RM-811.0) averaged 518 mg/l. The highest average concentration was 629 mg/l at the Omaha M.U.D. water intake (Station M-42, RM-626.2). The lowest average of 486 mg/l occurred at Station M-30 (RM-488.3). Ten of the 11 main stem stations exceeded 500 mg/l total dissolved solids.

Sulfates

Average sulfate concentrations (Table A-2) for the 8-day normal-weather October 1968 survey ranged between 166 mg/l at Station M-29 (RM-469.0) and 220 mg/l at Station M-32 (RM-525.1). Water released from Gavins Point Dam (RM-811.0) averaged 208 mg/l.

The sulfate concentrations for the January 1969 survey were similar to the October 1968 results. Concentrations ranged from 170 mg/l at Station M-30 (RM-488.3) to 224 mg/l at the Omaha M.U.D. water intake (Station M-42, RM-626.2).

Soluble Heavy Metals

A soluble iron concentration of 0.60 mg/l for the second 5-day composite at station M-39 (RM-610.5) was the only heavy metal concentration found within detectable limits of analytical methods for the October 1968 survey (Table A-3). Other metals were either absent or present in minute quantities.

Analyses for the January 1969 survey were not completed in time for inclusion in this report.

Grease

The concentration of grease from the daily composite from the Monroe Street and South Omaha sewers averaged 299 mg/l during the October 1968 survey. The actual amount of grease reaching the Missouri River following a privately operated recovery operation at the Monroe Street sewer was not determined.

The grease concentration in the effluent from the Sioux City, Iowa, sewage treatment plant during the October 1968 survey averaged 17 mg/l. The amount of grease removed through the sewage treatment plant was not determined.

Grease results from the January 1969 survey were not available for inclusion in this report.

TABLE NO. A-1

SUMMARY OF AVERAGE DISCHARGES

MISSOURI RIVER

OCTOBER 1968 and JANUARY 1969 SURVEYS

STATION	1968 DISCHARGES[1] cfs			1969 DISCHARGES[2] cfs	
	Oct. 7-16 Normal Fall	Oct. 17-18 Extremely Wet	Flow Ratio: Wet/Normal	Jan. 20-31 Non-Navigation	Flow Ratio: 1969/1968 Normal
MISSOURI RIVER:					
Gavin's Pt. Dam, South Dakota	31,200	28,500	0.91	16,900	0.54
Sioux City, Iowa	32,400	34,000	1.05	16,700	0.52
Omaha, Nebraska	33,100	45,900	1.39	15,100	0.46
Nebraska City, Nebraska	35,600	57,300	1.61	17,600	0.49
Rulo, Nebraska	36,300	70,600	1.94	18,700	0.52
St. Joseph, Missouri	36,600	70,400	1.92	19,900	0.54
TRIBUTARIES:					
Big Sioux River at Akron, Iowa	170	700	4.15	-	-
Boyer River at Logan, Iowa	270	1,520	5.63	-	-
Platte River near South Bend, Nebraska	3,450	17,100	4.96	3,350	0.97
WASTE SOURCES:[3]					
Sioux City, Iowa - STP	25.1 (=16.2 mgd)		-	22.6 (=14.6 mgd)	-
Council Bluffs, Iowa - STP	7.7 (=5.0 mgd)[4]		-	8.0 (=5.2 mgd)	-
Omaha, Nebraska Missouri R. STP	0[5]		-	24.8 (=16 mgd)	-
Monroe St. Sewer Omaha, Nebraska	64.4(=41.6 mgd)		-	-	-

[1] Average flows based on provisional U.S. Geological Survey data, except for waste sources.

[2] Average flows estimated by U.S Corps of Engrs., except for waste sources.

[3] Waste source flows are averages for sample days only and may be rain-affected.

[4] Flow estimated from information provided by Plant Personnel.

[5] No flow due to shutdown for system repairs. All sewage was bypassed raw from many outfalls along the waterfront.

Table A-2

Missouri River Survey - Summary of Results

Averages of (8-Day and 2-Day) Daily Discrete Samples [1]

October 1968 Survey

Name	River Mileage	TEMPERATURE °C		TURBIDITY Units		DISSOLVED OXYGEN mg/1		2-DAY BOD mg/1		5-DAY BOD mg/1		pH Units	
		8-Day	2-Day	8-Day	2-Day	8-Day	2-Day	8-Day	2-Day	8-Day	2-Day	8-Day	2-Day
MISSOURI RIVER:													
Gavin's Point Dam:	811.0	-	-	14[2]	-	-	-	-	-	-	-	8.3[2]	-
M-52	736.0	14	10	22	30	9.5	10.0	0.4	0.6	0.9	1.2	8.3	8.4
M-50	730.0	14	10	21	34	9.4	9.7	0.4	0.6	1.1	1.2	8.3	8.3
M-48	717.4	14	11	24	48	9.3	9.4	0.8	0.8	1.5	1.6	8.3	8.3
M-47	699.5	15	12	24	46	9.2	9.2	0.8	0.9	1.6	1.8	8.3	8.3
M-46	676.5	15	11	24	39	9.2	9.0	0.7	1.0	1.4	1.8	8.3	8.3
M-44	654.6	15	13	44	255	9.1	8.0	0.8	1.9	1.5	4.0	8.3	8.2
M-42	626.2	14	12	36	231	9.1	8.0	1.1	2.6	1.9	4.9	8.2	8.2
M-41	618.3	14	14	47	245	8.9	7.8	1.2	2.2	2.0	4.2	8.2	8.2
M-39	610.5	14	13	39	250	8.8	-	3.6	3.2	5.8	6.1	8.3	8.1
M-38	601.3	15	13	37	350	8.8	7.6	1.9	2.6	3.4	5.2	8.6	8.1
M-36	591.2	15	12	46	300	8.6	7.8	1.9	2.9	3.4	5.4	8.2	8.1
M-35	580.9	15	12	50	325	8.6	7.5	1.8	2.9	3.3	5.6	8.1	8.0
M-34	559.7	14	14	67	470	8.5	6.8	1.3	3.3	2.8	6.8	8.3	8.0
M-33	546.7	15	14	114	440	8.4	7.0	1.7	3.9	3.2	6.7	8.3	8.0
M-32	525.1	15	14	59	492	8.6	6.1	1.3	2.8	2.6	7.0	8.2	8.0
M-31	507.5	15	14	64	560	8.6	6.6	1.3	2.5	2.6	5.8	8.2	8.0
M-30	488.3	15	15	52	810	8.3	6.0	1.9	2.6	3.2	5.8	8.2	7.8
M-29	469.0	15	15	46	985	8.6	5.2	2.1	3.0	3.4	7.6	8.2	7.8
M-28	452.3	16	16	48	1120	8.6	5.6	1.8	-	3.0	-	8.3	8.0
TRIBUTARIES: [5]													
BS-51	734.0	14	11	20	30	12.0	6.0	4.6	3.4	9.1	6.0	8.4	8.0
S-45 [3]	664.0	-	10	6	1670	9.9	6.6	1.3	5.2	2.3	6.9	8.3	7.8
B-43	635.1	14	10	245	1850	8.2	5.7	5.0	8.1	9.2	14.0	8.1	7.8
PA-37A [4]	596.5	-	10	-	-	-	-	-	55	-	127	-	-
P-37	594.8	16	11	175	538	9.2	7.8	4.2	3.8	7.9	8.2	8.2	7.7
WASTE SOURCES: [5]													
SC-49	729.0	-	-	61	94	-	-	152	160	247	260	7.4	8.0
OM-40A	611.5	-	-	204	268	-	-	548	576	960	878	7.3	7.8
CB-40B	614	-	-	-	-	-	-	-	-	-	-	-	-

Table A-2 (cont'd)

STATION Name	River Mileage	ALKALINITY Ca CO_3 mg/1 8-Day	ALKALINITY 2-Day	HARDNESS Ca CO_3 mg/1 8-Day	HARDNESS 2-Day	CHLORIDE mg/1 8-Day	CHLORIDE 2-Day	SULFATE mg/1 8-Day	SULFATE 2-Day	SPECIFIC CONDUCTANCE umhos/cm at 25° C 8-Day	SPECIFIC CONDUCTANCE 2-Day	TOTAL SUSPENDED SOLIDS mg/1 8-Day	TOTAL SUSPENDED SOLIDS 2-Day	TOTAL DISSOLVED SOLIDS mg/1 8-Day	TOTAL DISSOLVED SOLIDS 2-Day
MISSOURI RIVER:															
Gavin's Point Dam:	811.0	169[2/]	-	238[2/]	-	12[2/]	-	208[2/]	-	800[2/]	-	45[2/]	-	474[2/]	-
M-52	736.0	166	160	258	254	11	13	203	212	800	750	55	-	471	-
M-50	730.0	165	160	249	275	12	14	214	245	820	880	62	87	484	497
M-48	717.4	167	160	252	258	12	14	209	188	790	720	44	147	494	365
M-47	699.5	174	154	257	254	11	15	191	245	800	730	61	114	552	341
M-46	676.5	160	158	254	258	12	13	210	212	790	740	58	102	496	398
M-44	654.6	197	156	264	254	12	19	199	188	790	720	155	715	533	287
M-42	626.2	172	168	237	271	13	13	185	182	800	680	91	1020	532	330
M-41	618.3	169	154	263	238	12	17	180	158	790	710	120	740	540	326
M-39	610.5	164	114	254	238	13	17	216	172	790	680	95	850	478	469
M-38	601.3	168	147	250	238	16	17	210	170	790	770	95	998	493	313
M-36	591.2	167	154	249	242	15	18	187	198	790	770	136	1100	485	327
M-35	580.9	168	180	272	258	15	18	172	330	790	640	185	1340	490	-
M-34	559.7	169	148	262	226	19	27	164	185	790	640	220	1610	493	500
M-33	546.7	170	146	256	246	17	27	187	180	780	650	238	1780	482	-
M-32	525.1	174	158	258	246	20	32	220	128	780	660	278	1120	645	245
M-31	507.5	165	160	253	258	18	28	209	-	800	640	142	1310	480	516
M-30	488.3	170	152	258	258	22	16	194	162	700	600	110	1480	512	449
M-29	469.0	173	145	261	242	21	21	166	145	790	580	123	2550	468	312
M-28	452.3	163	158	254	246	17	20	170	165	780	600	131	2780	472	198
TRIBUTARIES: [5/]															
BS-51	734.0	214	177	388	385	45	52	169	142	1040	900	55	71	547	422
S-45[3/]	664.0	255	149	350	246	13	13	40	26	660	340	10	3530	423	3670
B-43	635.1	251	174	340	242	45	22	78	37	700	400	729	999	392	2860
PA-37A[4/]	596.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P-37	594.8	158	130	199	184	69	69	68	72	810	620	763	-	504	-
WASTE SOURCES: [5/]															
SC-49	729.0	412	374	439	344	243	300	236	140	2230	1900	109	170	1330	1020
OM-40A	611.5	243	233	263	293	481	499	234	188	2300	2220	891	840	1650	1690
CB-40B	614	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1/ 8-day average is for typical fall weather, where total precipitation was 0.46 in. in Omaha; 2-day average is for extremely wet weather (3.61 in. of precipitation).

2/ Average of two 5-day composite samples (Gavin's Point Dam only).

3/ Averages for 7 days of typical fall and 3 days of extremely wet weather.

4/ Average for 3 days of extremely wet weather.

5/ River mileage refers to point where tributary or waste source enters Missouri River. Samples were collected on tributary or waste source upstream from confluence.

Table A-3

Missouri River Survey - Summary of Results

5-Day Composite Samples Obtained During October 1968

STATION Name	River Mileage	TOTAL PHOSPHORUS mg/1 Normal 5-Day	TOTAL PHOSPHORUS mg/1 Wet 5-Day	NH_3as N mg/1 Normal 5-Day	NH_3as N mg/1 Wet 5-Day	NO_3as N mg/1 Normal 5-Day	NO_3as N mg/1 Wet 5-Day	Org. N as N mg/1 Normal 5-Day	Org. N as N mg/1 Wet 5-Day	TOTAL NITROGEN mg/1 Normal 5-Day	TOTAL NITROGEN mg/1 Wet 5-Day	Ca mg/1	Mg mg/1	Total Org. CARBON mg/1
MISSOURI RIVER:														
Gavin's Point Dam:	811.0	0.04	0.03	0.08	0.06	0.2	0.3	0.4	0.2	0.7	0.6			
M-52	736.0	0.05	0.07	0.09	0.12	0.2	0.4	1.2	0.4	1.5	0.9	69	20	5
M-50	730.0	0.07	0.11	0.20	0.16	0.2	0.2	1.0	0.4	1.4	0.8	70	20	6
M-48	717.4	0.07	0.11	<0.01	0.20	0.2	0.2	0.7	0.6	0.9	1.0	70	20	71
M-47	699.5	0.06	0.15	0.20	0.28	0.2	0.3	0.8	0.6	1.2	1.2	68	22	
M-46	676.5	0.07	0.12	0.15	0.18	0.2	0.2	0.9	0.7	1.2	1.1	67	20	6
M-44	654.6	0.08	0.54	0.24	0.27	0.3	0.4	0.6	1.5	1.1	2.2	68	22	9
M-42	626.2	0.12	0.49	0.07	0.19	0.3	0.4	0.9	1.3	1.3	1.9	65	20	8
M-41	618.3	0.20	0.40	0.12	0.17	0.3	0.4	0.8	2.0	1.2	2.6	92	6	8
M-39	610.5	0.24	0.37	0.17	0.22	0.3	0.4	0.8	1.5	1.3	2.1	68	20	9
M-38	601.3	0.20	0.35	0.09	0.15	0.3	0.4	0.9	1.1	1.3	1.6	68	20	8
M-36	591.2	0.30	0.35	0.07	0.47	0.4	0.4	1.0	1.5	1.5	2.4	63	22	10
M-35	580.9	0.29	0.38	0.14	0.52	0.3	0.4	1.2	1.1	1.6	2.0	70	23	10
M-34	559.7	0.25	0.70	0.19	0.51	0.3	0.6	1.0	2.9	1.5	4.0	68	20	14
M-33	546.7	0.27	0.73	0.13	1.13	0.4	0.6	1.4	2.2	1.9	3.9	70	20	14
M-32	525.1	0.28	0.60	0.13	1.55	0.3	0.5	1.9	1.9	2.3	4.0	66	22	12
M-31	507.5	0.27	0.58	0.14	0.18	0.4	0.6	1.5	1.8	2.0	2.6	66	22	12
M-30	488.3	0.26	0.73	0.25	0.26	0.3	0.7	1.0	2.0	1.6	3.0	68	22	14
M-29	469.0	0.33	0.92	0.17	0.28	0.3	1.0	1.1	2.8	1.6	4.1	68	21	16
M-28	452.3	0.26	0.60	0.18	0.21	0.4	0.7	2.3	1.6	2.9	2.5	69	20	12
TRIBUTARIES: 2/														
BS-51	734.0	0.29	0.32	0.39	0.62	0.2	1.3	1.9	1.2	2.5	3.1	94	37	11
S-45	664.0	0.17	3.00	0.10	0.72	0.5	1.6	0.7	7.4	1.3	9.7	72	32	30
B-43	635.1	2.10	2.85	0.64	0.52	3.0	3.5	5.7	4.9	9.3	8.9	72	36	38
PA-37A	596.5	-	-	-	-	-	-	-	-	-	-	-	-	-
P-37	594.8	0.80	1.50	0.43	0.59	0.5	0.5	2.1	3.4	3.0	4.5	61	11	21
WASTE SOURCES: 2/														
SC-49	729.0	10.6	9.6	66.8	60.0	<0.1	<0.1	12.0	13.7	78.8	73.8	113	34	90
OM-40A	611.5	11.4	12.0	36.8	39.8	0.5	<0.1	30.0	160	67.2	199.8	70	21	245
CB-40B	614	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A-3 (cont'd)

STATION		1/	1/	1/	1/	Tot 1/	1/	1/	1/	1/	1/	1/	1/	1/	1/
Name	River Mileage	Ba mg/1	Cd mg/1	Fe mg/1	Mn mg/1	Cr mg/1	As mg/1	Cu mg/1	Pb mg/1	Ni mg/1	Zn mg/1	B mg/1	Na mg/1	K mg/1	F mg/1
MISSOURI RIVER:															
Gavin's Point Dam:	811.0	-	-	-	-	-	-	-	-	-	-	0.118	-	-	-
M-52	736.0	<1.0	<0.02	<0.30	<0.05	<0.05	0.0	<0.05	<0.05	<0.10	0.06	0.113	15	7.7	0.57
M-50	730.0	-	-	-	-	-	-	-	-	-	-	-	14	7.5	0.59
M-48	717.4	<1.0	<0.02	<0.30	<0.05	<0.05	0.0	<0.05	<0.05	<0.10	<0.05	0.116	-	-	-
M-47	699.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
M-46	676.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
M-44	654.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
M-42	626.2	<1.0	<0.02	<0.30	<0.05	<0.05	0.0	<0.05	<0.05	<0.10	-	0.111	13	8.0	0.66
M-41	618.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
M-39	610.5	<1.0	<0.02	<0.45	<0.05	<0.05	0.0	<0.05	<0.05	<0.10	<0.05	0.113	-	-	-
M-38	601.3	<1.0	<0.02	<0.30	<0.05	<0.05	0.0	<0.05	<0.05	<0.10	<0.05	0.116	14	8.0	0.62
M-36	591.2	-	-	-	-	-	-	-	-	-	-	-	14	8.7	0.64
M-35	580.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
M-34	559.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
M-33	546.7	<1.0	<0.02	<0.30	<0.05	<0.05	0.0	<0.05	<0.05	<0.10	<0.05	0.150	-	-	-
M-32	525.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
M-31	507.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
M-30	488.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
M-29	469.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
M-28	452.5	<1.0	0.02	<0.30	<0.05	<0.05	0.0	<0.05	<0.05	0.10	<0.05	0.099	13	8.6	0.78

1/ Soluble concentration

2/ River Mileage refers to point where tributary or waste source enters Missouri River. Samples were collected on tributary or waste source upstream from confluence.

TABLE NO. A-4

Coliform Bacteria
Summary of 8-and 2-Day Geometric Means for Discrete Samples
Missouri River
October 1968 Survey

Station Desig-nation	Station River Mileage	Total Coliforms MPN/100 ml 8-Day	Total Coliforms MPN/100 ml 2-Day	Fecal Coliforms MPN/100 ml 8-Day	Fecal Coliforms MPN/100 ml 2-Day
MISSOURI RIVER:					
Gavins Pt. Dam	811.0	250 [1]		< 125 [1]	
M-52	736.0	1,380	74,800	225	30,300
M-50	730.0	2,400	74,800	240	47,000
M-48	717.4	62,800	265,000	14,300	116,000
M-47	699.5	57,100	230,000	26,600	108,000
M-46	676.5	53,000	213,000	18,900	149,000
M-44	654.6	39,500	852,000	9,000	278,000
M-42	626.2	52,300	414,000	8,300	207,000
M-41	618.3	46,600	802,000	11,200	207,000
M-39	610.5	256,000	330,000	61,000	230,000
M-38	601.3	165,000	460,000	45,000	330,000
M-36	591.3	174,000	790,000	53,500	490,000
M-35	580.9	130,000	790,000	38,000	330,000
M-34	559.7	167,000	1,440,000	50,800	1,120,000
M-33	546.7	189,000	> 727,000	38,500	460,000
M-32	525.1	100,000	767,000	18,900	352,000
M-31	507.5	134,000	838,000	28,100	435,000
M-30	488.3	154,000	-	28,400	280,000
M-29	469.0	148,000	-	14,600	-
M-28	452.3	57,700	852,000	6,500	232,000
TRIBUTARIES [4]					
BS-51	734.0	1,100	17,000	110	4,000
S-45	664.0	15,000	2,400,000	3,900	2,000,000
B-43	635.1	110,000	2,000,000	15,000	1,400,000
PA-37A	596.5	-	16,000,000 [2]	-	11,000,000 [2]
P-37	594.8	27,700	620,000	11,100	290,000
WASTE SOURCES [4]					
SC-49	729.0	75,000,000	49,000,000	20,000,000	49,000,000
OM-40 A	611.5	19,000,000	30,000,000	7,800,000	11,000,000
CB-40 B	614	160,000,000 [3]	-	35,000,000 [3]	-

[1] Average of two grab samples.

[2] Average for 3 days influenced by extremely wet weather.

[3] Single grab sample during typical Fall weather.

[4] River Mileage refers to point where tributary or waste source enters Missouri River. Samples were collected on tributary or waste source upstream from confluence.

TABLE NO. A-5

Summary of
Other Constituents
Missouri River
October, 1968 Survey

Station		Cyanide, µg/l		Phenol, µg/l		Total[3] Organic Chlorine µg/l	Chloroform[3] Extract mg/l	Uranium[4] µg/l	Ra226 [4] pc/l
Designation	River Mileage	Avg.[1]	Maximum	Avg.[2]	Maximum				
MISSOURI RIVER:									
Gavins Pt. Dam	811.0	-	-	-	-	126.0	5.5	-	-
M-52	736.0	< 4.3	12.2	< 1.5	2.0	-	-	4.3	0.02
M-48	717.4	6.2	14.0	< 1.5	2.0	56.5	0.0	-	-
M-42	626.2	< 2.7	5.4	-	-	138.2	26.1	-	-
M-39	610.5	< 5.1	8.4	< 1.5	2.0	-	-	-	-
M-38	601.3	< 1.0	< 1.0	< 1.5	2.0	264.3	9.4	-	-
M-36	-	-	-	-	-	-	-	2.5	0.07
M-33	546.7	5.6[5]	15.2	< 1.5	2.0	-	-	-	-
M-28	452.3	4.7	11.2	< 1.5	2.0	32.8	3.7		
TRIBUTARIES:[6]									
BS-51	734.0	-	-	-	-	-	-	4.3	0.07
S-45	664.0	-	-	-	-	-	-	3.9	0.07
B-43	635.1	-	-	-	-	-	-	4.1	0.19
P-37	594.8	-	-	-	-	-	-	6.4	0.12
WASTE SOURCES:[6]									
OM-40 A	611.5	-	-	-	-	-	133.5	-	-

[1] Average of 3 to 4 grab samples during typical Fall and wet weather.

[2] Average of 2 grab samples during typical Fall weather.

[3] Single grab sample during typical Fall weather.

[4] Composite for 10 samples collected both during typical Fall and extremely wet weather.

[5] Includes a maximum discrete value of 15.2 µg/l.

[6] River Mileage refers to point where tributary or waste source enters Missouri River. Samples were collected on tributary or waste source upstream from confluence.

Table No. A-6
Summary of Available Data[1]
Missouri River
January 20-31, 1969 Survey

Station Designation	Station River Mile	Temp °C	Dissolved Oxygen mg/l	BOD 2 day mg/l	BOD 5 day mg/l	Coliform Bacteria Total MPN/100 ml	Coliform Bacteria Fecal MPN/100 ml	Fecal Strep MF/100 ml	pH Units	Alkalinity mg/l $CaCO_3$	Turbidity Units	Tot. Sus. Solids mg/l	Total Dissolved Solids mg/l	Specific Conductance µmho/cm	Chloride mg/l	Sulfate mg/l	Cyanide µg/l	Phenol µg/l
MISSOURI RIVER:																		
Gavins Pt. Dam	M-811.0	-	-	-	-	< 30	< 20	20	-	-	2	[illegible]	518	700	11	[illegible]		
M-52A	M-732.8	-0.4	12.7	0.4	1.1	1,000	310	220	8.1	175	19	48	546	800	12	214	< 1.2	< 1.2
M-48A	M-718.3	0.5[2]	12.5	0.8	1.6	45,000	11,000	16,000	8.1	174	10	23	553	810	13	213	< 1.9	< 1.2
M-47	M-699.5	0.4	12.7	1.0	2.0	39,000	15,000	27,000	8.1	176	9	18	554	800	14	213		
M-42	M-626.2	-0.2	13.2	0.8	1.4	< 6,000	< 4,900	5,900	8.1	191	9	25	629	860	15	224	< 3.6	< 1
M-38	M-601.3	0.2[2]	12.8	2.2	3.6	54,000	14,000	61,000	8.1	187	8	17	570	810	16	221	< 1.8	< 1
M-35	M-580.9	-0.2	12.5	1.7	2.7	45,000	19,000	38,000	8.0	188	8	17	552	800	18	206		
M-34	M-559.7	-0.2[2]	10.6	1.1	1.9	22,000	9,500	16,000	8.0	185	7	12	525	760	25	175		
M-32	M-525.1	-0.2	9.4	1.1	2.3	7,300	2,000	5,900	7.9	182	6	9	527	750	22	173		
M-30[1]	M-488.3		9.1	1.7	3.4	95,000	5,800	17,000	7.8	165	15	27	486	710	22	170		
M-28	M-452.3		9.6	1.5	3.0	> 16,000	2,800	5,600	7.8	175	12	28	511	740	23	177	< 2.3	< 2
TRIBUTARIES:[3]																		
PA-37A	M-596.5	0.9	3.9	40	82	4,000,000	590,000	530,000	7.8	289	41	100	646	1,010	96	80		
P-37	M-594.8	-0.4	10.0	1.1	2.1	36,000	19,000	8,100	7.9	181	16	32	455	700	56	81		
WASTE SOURCES:																		
SO-49	M-729.0	-	-	207	340	> 19,000,000	5,200,000	8,800,000	7.6	472	55	130	1,482	2,280	334	174		
OM-40A[4]	M-611.5	-	-	162	256	11,000,000	3,000,000	17,000,000	7.9	208	52	91	1,132	1,650	290	238		
CB-40B[5]	M-614	-	-	173	335	23,000,000	4,300,000	1,300,000	7.3	213	55	99	908	1,320	113	242		

(1) Data presently available; other constituents to be analysed.

(2) Temperatures may be influenced by cooling water discharges from electrical power production.

(3) River Mileage refers to point where tributary or waste source enters Missouri River. Samples were collected on tributary or waste source upstream from confluence.

(4) Averages shown are based on 5 samples collected during the first week of the survey: January 20-24, 1969.

(5) Averages shown are based on 5 samples collected during the second week of the survey: January 27-31, 1969.

TABLE No. A-7
STATION DESCRIPTIONS
Missouri River Basin Survey

Station	River Mile	Description
M-28	452.3	Missouri R. at St. Joseph Waterworks intake (0.3 mi. below Daymark right bank).
M-29	469.0	Missouri R. 0.5 mi. above Charleston landing (Daymark - left bank).
M-30	488.3	Missouri R. at White Cloud, Kan. (at power cable X-ing).
M-31	507.5	Missouri R. 9.5 mi. above Rulo, Neb. (at landing 0.2 mi. below light - left bank).
M-32	525.1	Missouri R. at boat landing (at Morgan Bend, upper light - left bank).
M-33	546.7	Missouri R. at Peru Sportsman's Club ramp (0.2 mi. above Barney Bend light - right bank).
M-34	559.7	Missouri R. below Nebraska City (0.2 mi. above Fraziers light - left bank).
M-35	580.9	Missouri R. at Bartlett, Iowa (at Shenandoah Boat Club ramp).
M-36	591.2	Missouri R. at Plattsmouth, Neb. (0.2 mi. below Pollock light - right bank).
P-37	594.8	Platte R. at U. S. Hwy. 75 bridge, Nebraska
M-38	601.3	Missouri R. at Bellevue, Neb. (0.1 mi. below St. Hwy. 370 bridge).
M-39	610.5	Missouri R. below Omaha STP outfall (at power cable X-ing).
OM-40	611.5	Composite sample of 7 parts Monroe St. Sewer effluent and 1 part South Omaha Sewer, Omaha, Nebr. (approx. river mileage)
M-41	618.3	Missouri R. at I. C. RR bridge.
M-42	626.2	Missouri R. at Omaha Waterworks intake (0.3 mi. below Hwy. 36 bridge).
B-43	635.1	Boyer R. at I-29 Hwy. bridge, Iowa.
M-44	654.6	Missouri R. above Blair, Neb. (at Tyson Boat Marina 0.2 mi. above light - right bank).
S-45	664.0	Soldier R. at I-29 Hwy. bridge, Iowa.
M-46	676.5	Missouri R. (at Upper Sioux Reach upper light - left bank).
M-47	699.5	Missouri R. at Lighthouse Marina (also called Don Ruth Marina, 6 mi. from Whiting, Iowa).
M-48	717.4	Missouri R. below Sioux City STP outfall (at power cable X-ing).
SC-49	729.0	Sioux City Sewage Treatment Plant effluent (approx. river mileage).
M-50	730.0	Missouri R. below Floyd R. confluence - Sioux City, Iowa (at power cable X-ing).
BS-51	734.0	Big Sioux R. above confluence.
M-52	736.0	Missouri R. 2 mi. above confluence (at I-29 Hwy. bridge).
Gavins Point Dam	811.0	Dam above Yankton, S. D. (Corps of Engrs.).
PA-37A	596.5	Big Papillion Creek at Offut Air Force Base Road to Capehart, Nebraska - off U. S. Hwy. 75.
OM-40A	611.5	Omaha Missouri River Sewage Treatment Plant effluent (approx. river mi.).
CB-40B	614.0	Council Bluffs Sewage Treatment Plant effluent (approx. river mi.).
M-48A	718.3	Iowa Power and Light Co. Power Plant - left bank.
M-52A	732.8	Missouri River 0.5 mile above U. S. 73 Hwy. bridge.

FIGURE A-1
LOCATION MAP
MISSOURI RIVER
October, 1968 - January, 1969

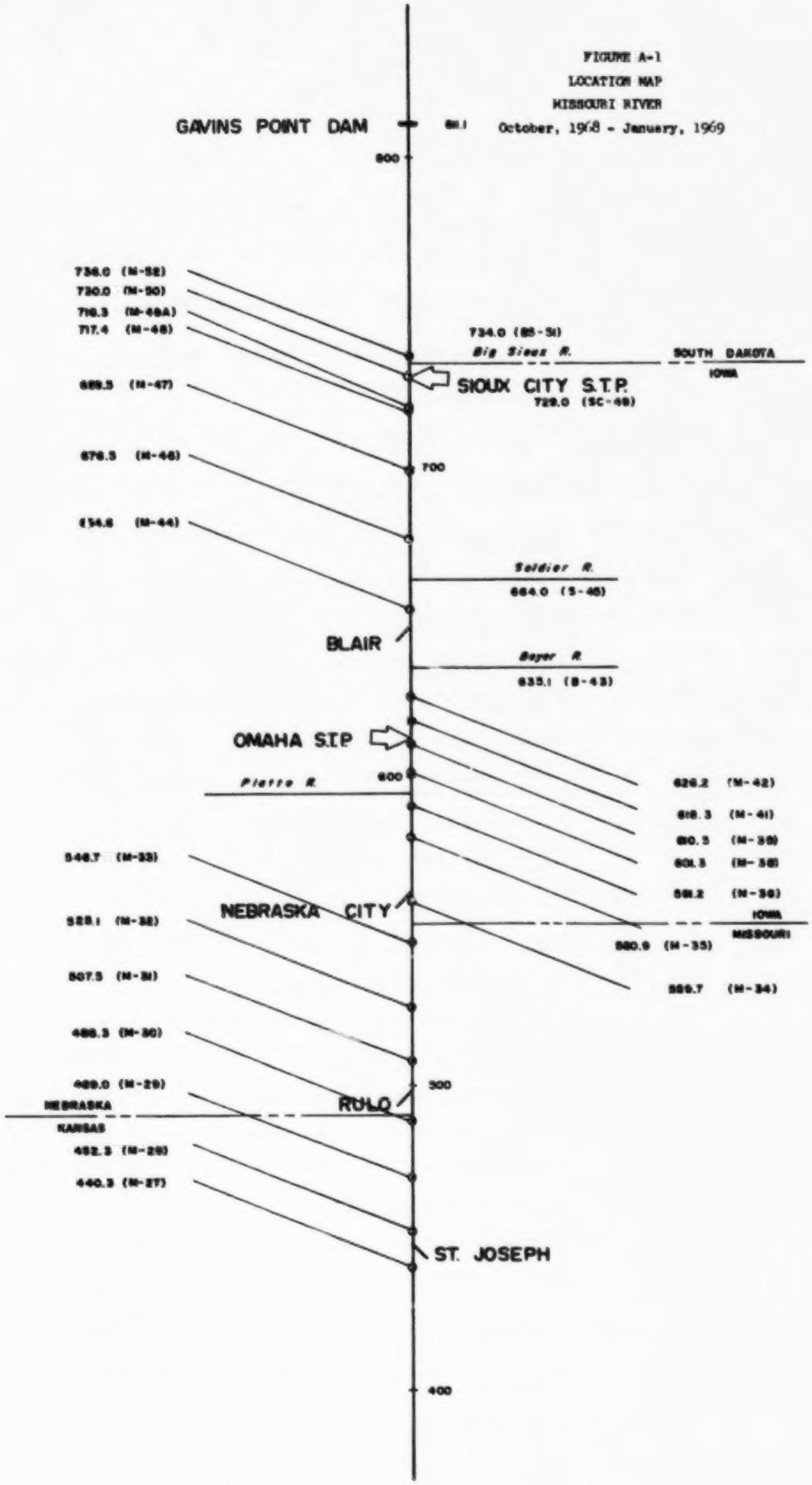
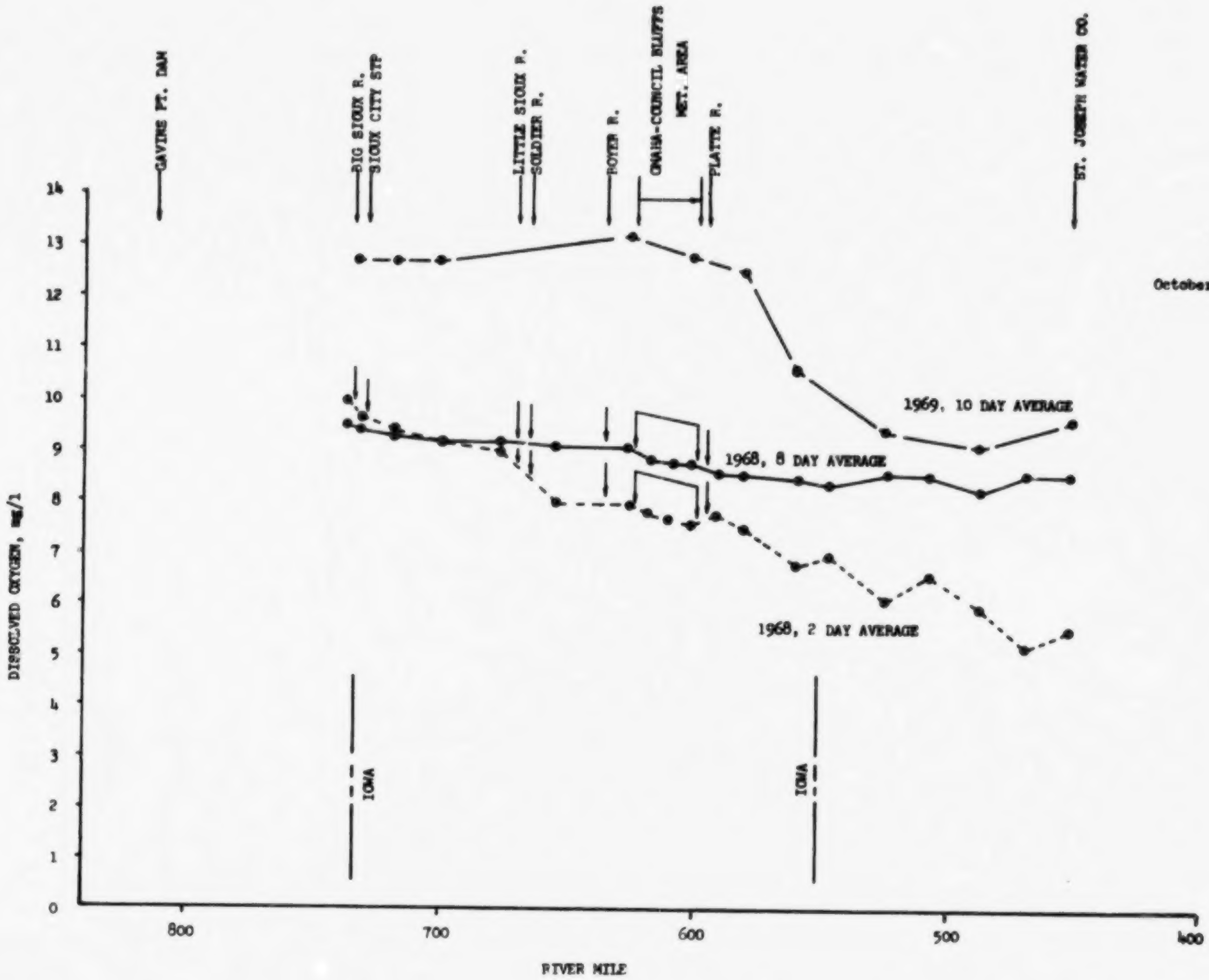

GAVINS POINT DAM
811.1
800
736.0 (M-52)
730.0 (M-50)
719.3 (M-49A)
717.4 (M-48)
734.0 (BS-31)
Big Sioux R.
SOUTH DAKOTA
IOWA
SIOUX CITY S.T.P.
729.0 (SC-49)
699.5 (M-47)
700
676.5 (M-46)
654.8 (M-44)
Soldier R.
664.0 (S-46)
BLAIR
Boyer R.
635.1 (B-43)
OMAHA S.T.P.
Platte R.
600
626.2 (M-42)
618.3 (M-41)
610.5 (M-39)
601.5 (M-38)
591.2 (M-36)
546.7 (M-33)
NEBRASKA CITY
IOWA
MISSOURI
525.1 (M-32)
580.9 (M-35)
507.5 (M-31)
559.7 (M-34)
488.3 (M-30)
469.0 (M-29)
500
NEBRASKA
KANSAS
RULO
452.3 (M-28)
440.3 (M-27)
ST. JOSEPH
400

FIGURE A-2
DISSOLVED OXYGEN
MISSOURI RIVER
October, 1968 - January, 1969



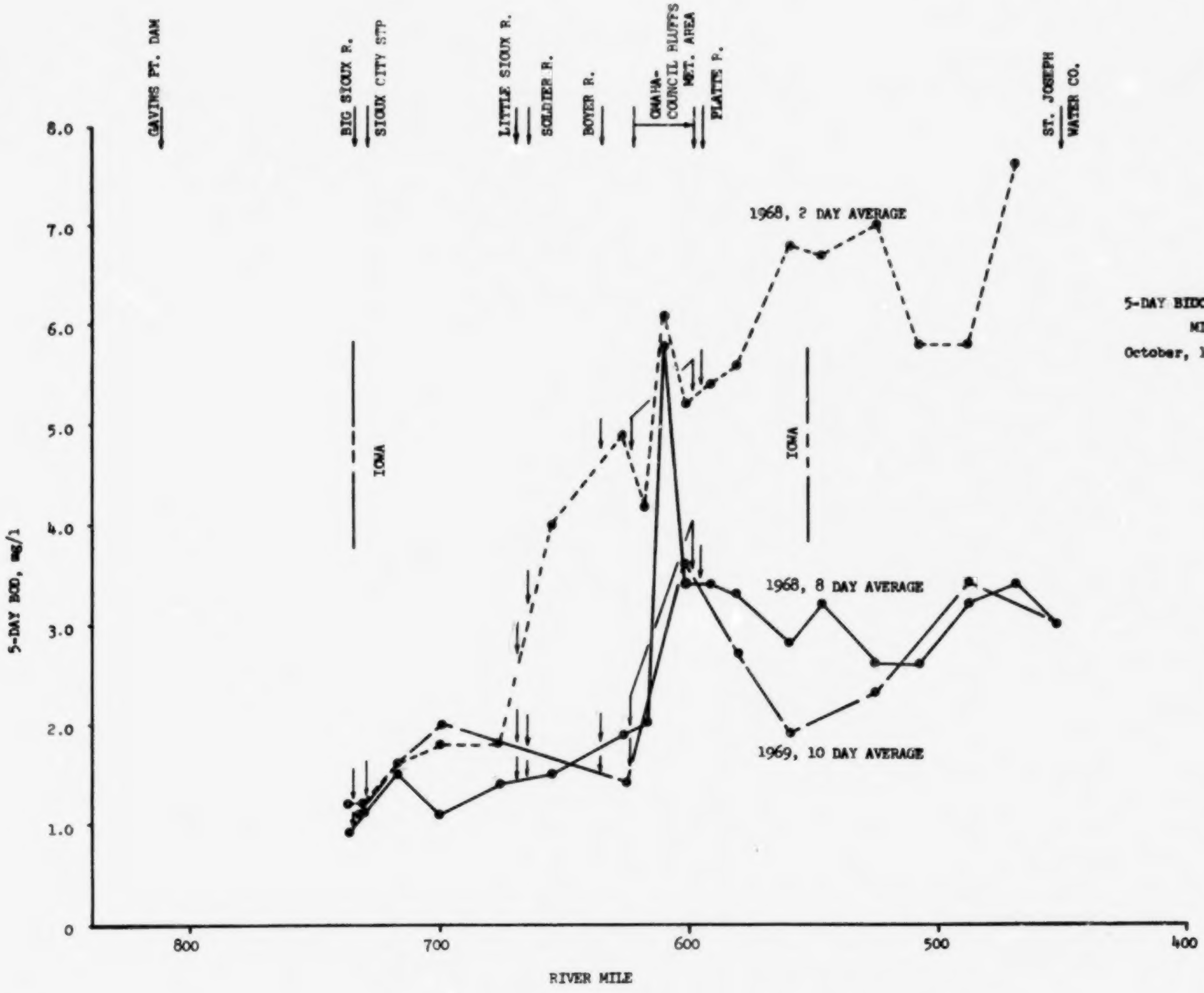


FIGURE A-3
5-DAY BIOCHEMICAL OXYGEN DEMAND
MISSOURI RIVER
October, 1968 - January, 1969

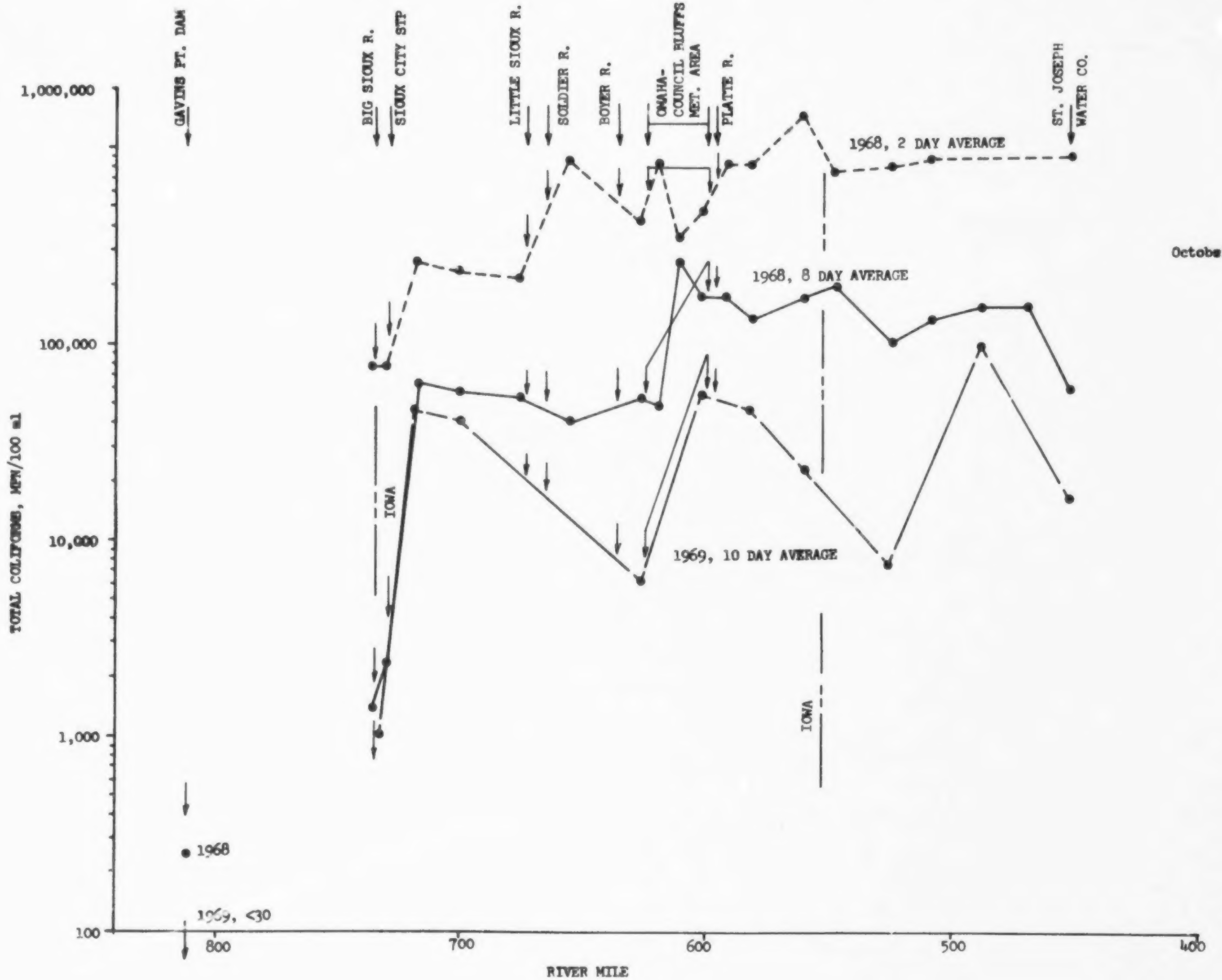
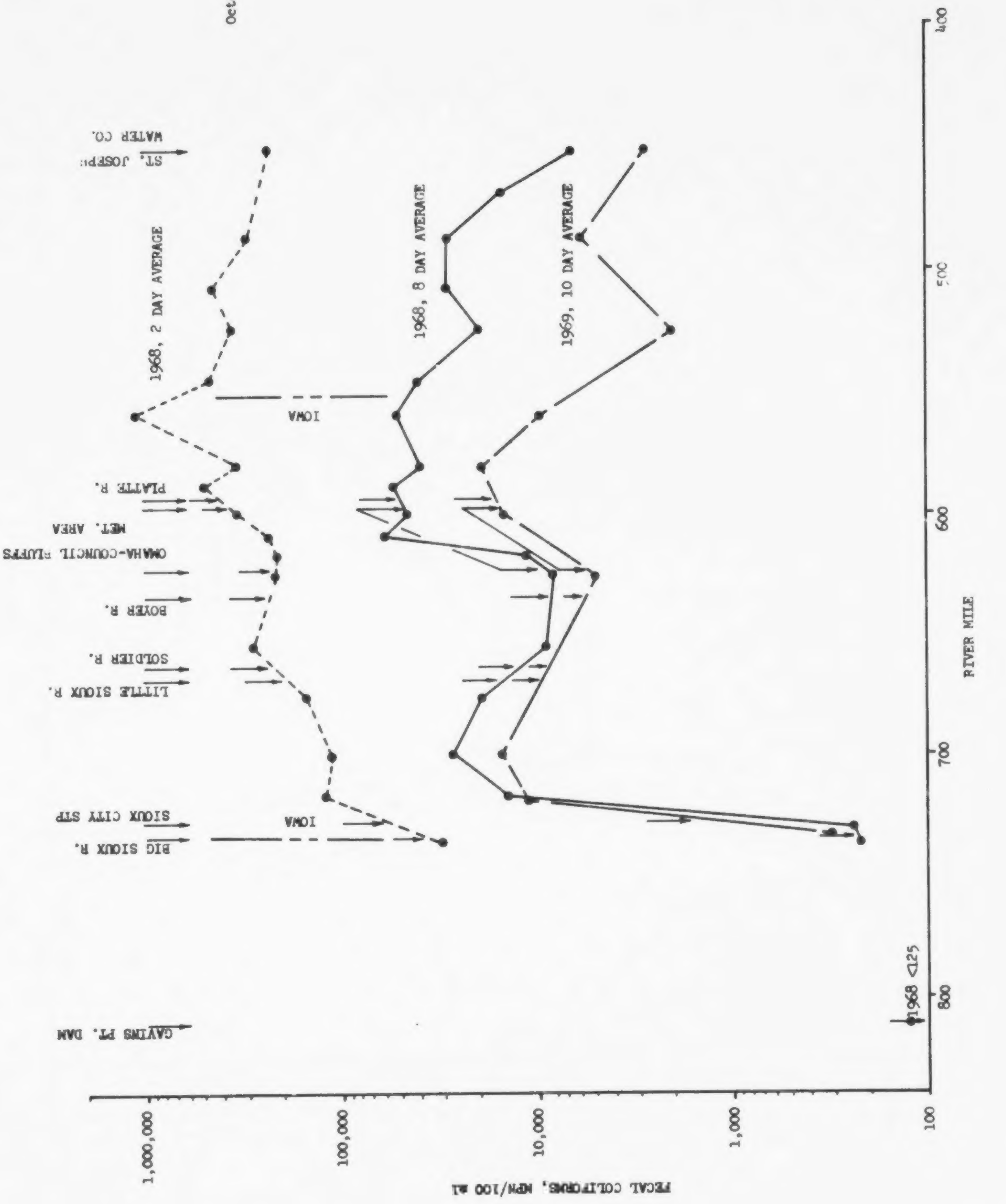


FIGURE A-4
TOTAL COLIFORMS
MISSOURI RIVER
October, 1968 - January, 1969

FIGURE A-5
FECAL COLIFORMS
MISSOURI RIVER
October 1968 - January, 1969



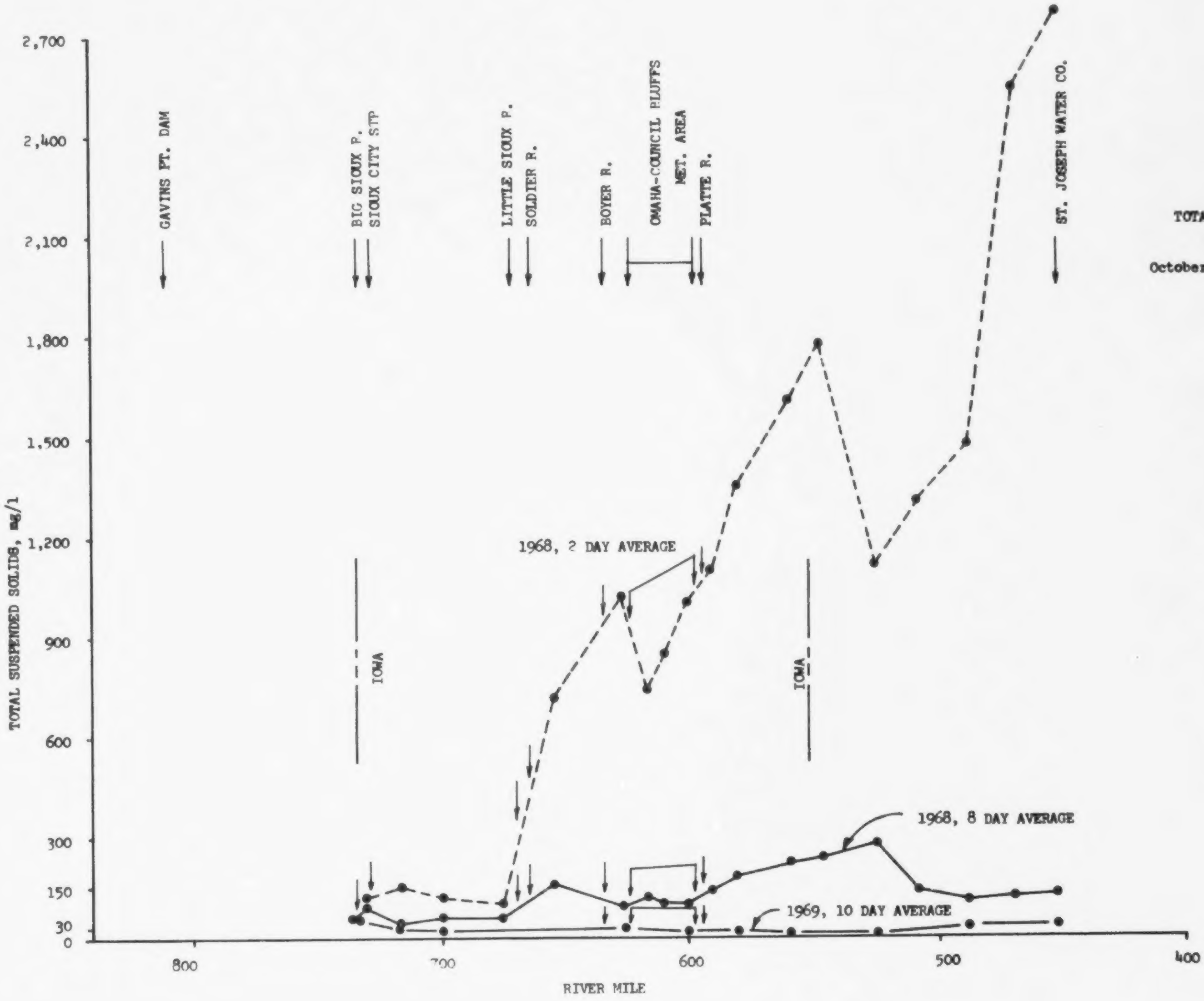
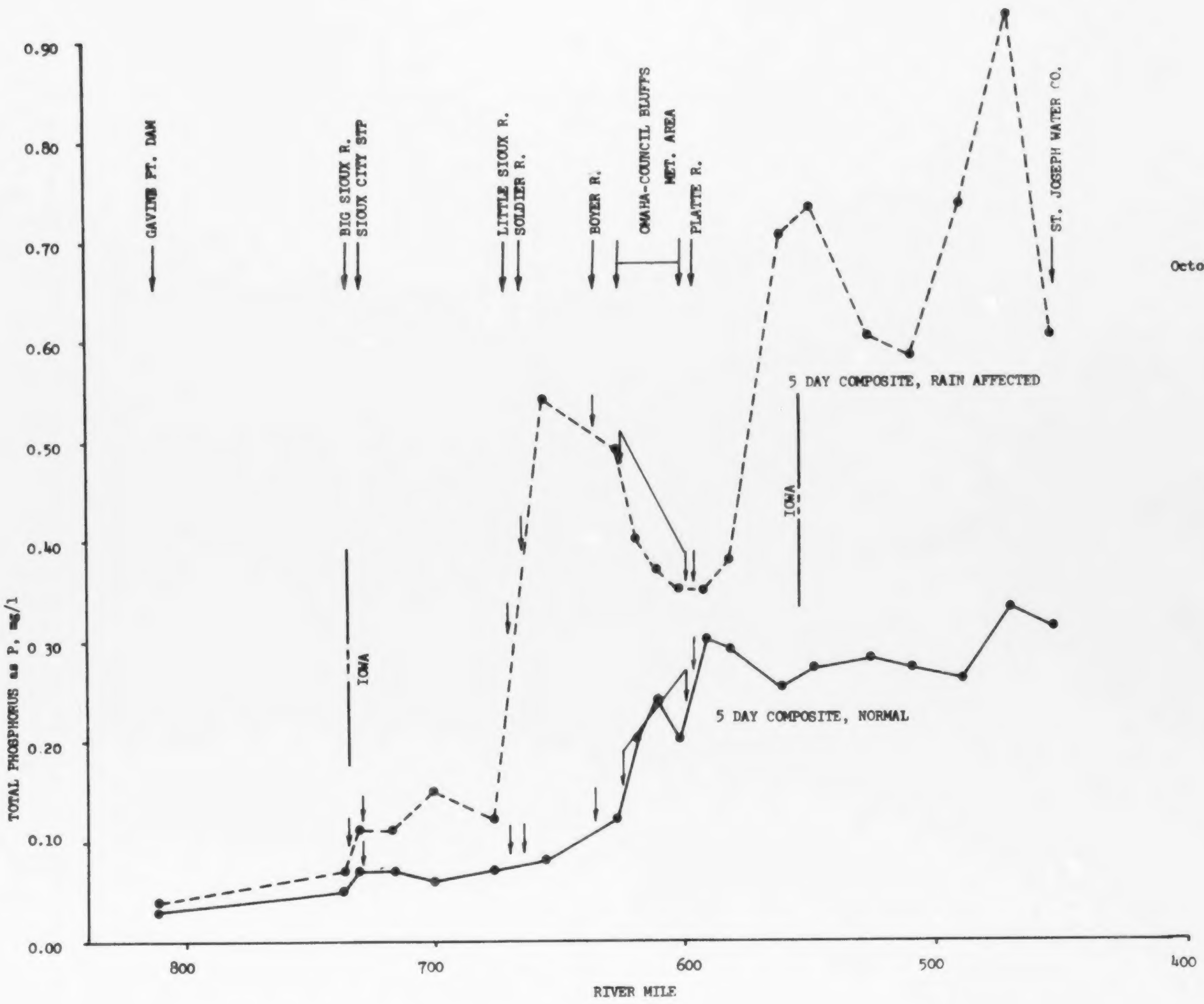


FIGURE A-6
TOTAL SUSPENDED SOLIDS
MISSOURI RIVER
October, 1968 - January, 1969

FIGURE A-7
TOTAL PHOSPHORUS
MISSOURI RIVER
October, 1968 - January, 1969



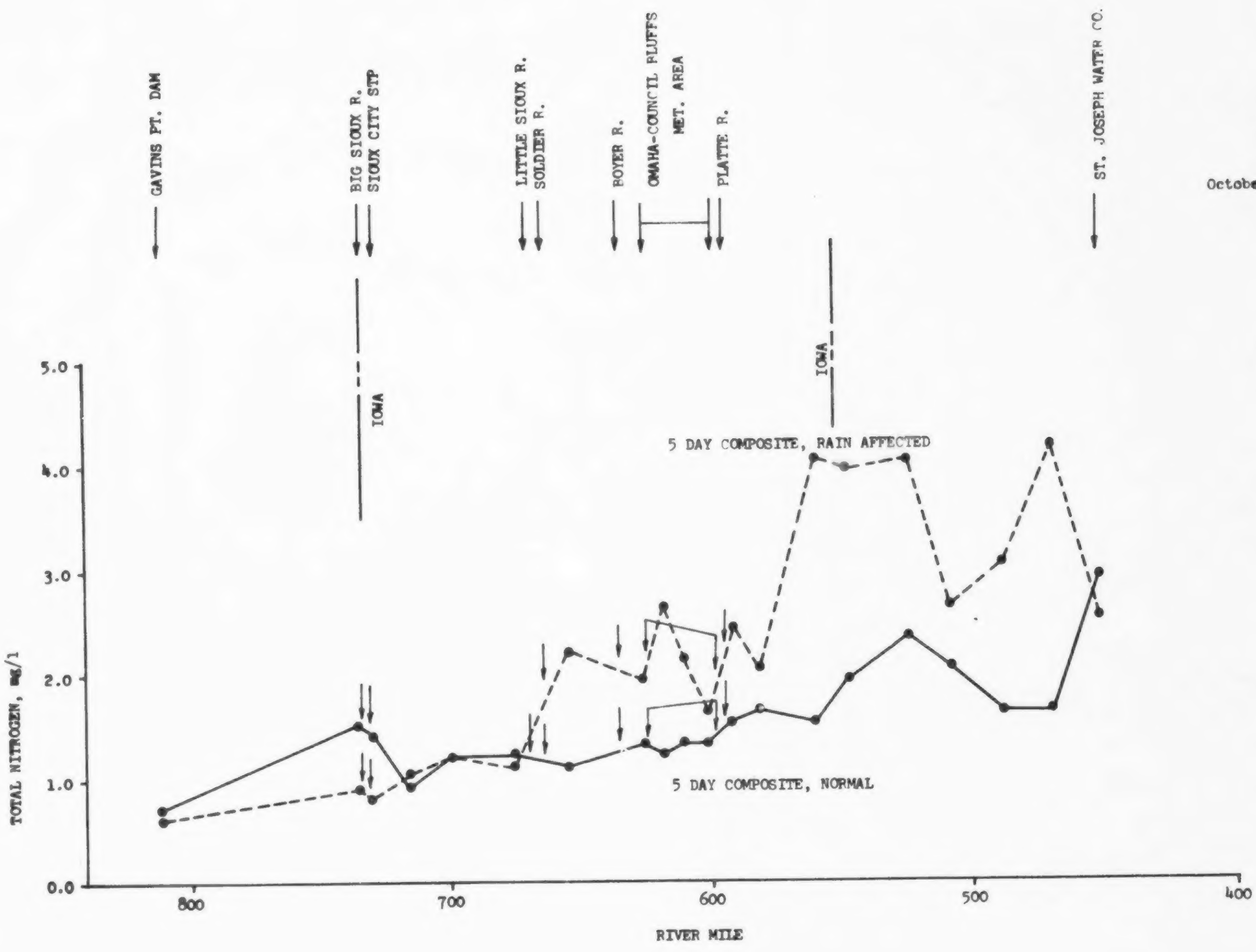


FIGURE A-8
TOTAL NITROGEN
MISSOURI RIVER
October, 1968 - January, 1969

APPENDIX B

BIOLOGICAL ASPECTS OF WATER QUALITY IN IOWA REACHES OF THE MISSOURI RIVER

CONCLUSIONS

The 286 miles of the Missouri River downstream from Sioux City, Iowa, reflected different degrees of water quality degradation. At least 54 miles were severely degraded by pollution. The remaining approximately 232 miles were good water quality.

1. From Sioux City, Iowa to Omaha, Nebraska and Council Bluffs, Iowa, stream bed animals reflected unpolluted conditions with the exception of localized degradation in the Sioux City area.
2. Wastes discharged from the Omaha and Council Bluffs area polluted the river, both aesthetically and biologically. Severe degradation of the bottom associated organisms occurred for 54 miles downstream. Objectionable floating solids (grease and chunks of animal fat) were observed from the Omaha and Council Bluffs area downstream past the St. Joseph, Mo. water supply intake, a distance of approximately 166 miles.
3. Severely degraded waters were found in tributaries of the Missouri River; tributaries with polluted water were the Big Sioux River, Floyd River, Soldier Creek and Boyer River.

A. Big Sioux River (Iowa and South Dakota) bottom organisms indicated unsuitable conditions for sensitive forms. The presence of organic sludge results from inadequately treated wastewaters.

B. The Floyd River (Iowa) bottom was composed of paunch manure and organic sludge, and supported only the most tolerant bottom organisms.

C. Water quality in both the Soldier Creek and Boyer River was degraded. However, water flow from each stream was low in volume and the streams had no observable effect on the Missouri River.

4. Suspended algae in the Missouri River increased in numbers from 1,000 cells per ml to 6,000 cells per ml downstream from Omaha, Nebraska and Council Bluffs, Iowa. However, the algal population created no known nuisances or problems.

INTRODUCTION

Requested by the Regional Director of the Missouri Basin Region, Federal Water Pollution Control Administration, a biological survey to determine water quality of the Missouri River from Sioux City, Iowa, downstream to Hermann, Missouri, was conducted from October 7 to October 16, 1968. Results of the survey from Sioux City, Iowa, to St. Joseph, Missouri, are presented in this report.

The Missouri River included in this survey flows southeast from South Dakota and is the boundary between Nebraska and Iowa, and a portion of Kansas and Missouri (Figure B1). This stream reach is 286 miles long and drains approximately 424,300 square miles. Major tributaries entering this reach are the Big Sioux River, Floyd River, Soldier Creek, Boyer River, and Platte River.

This reach is bordered by agricultural lands and has industrial complexes located in the larger cities. Major cities are Sioux City, Iowa; Council Bluffs, Iowa; Omaha, Nebraska and St. Joseph, Missouri. The river is used mainly for water supply, transportation and irrigation. Water-associated sports such as fishing and boating are not fully developed.

The river's high velocity of three miles per hour continually erodes unprotected banks and constantly shifts the sandy bottom. The water is turbid. To limit floods, bank erosion, and to stabilize the channel, the U. S. Army Corps of Engineers constructed six main stem impoundments upstream from Sioux City and channelized the river downstream from Sioux City. Flows are controlled by the release of water from upstream impoundments. The channel has been stabilized and erosion has been controlled by placing pile dikes (rock braced with piling) parallel or perpendicular to river flow.

Biological features studied were bottom inhabiting invertebrate organisms and suspended algae (phytoplankton). Sampling was at approximately 20 river mile intervals except in areas affected by waste discharges where additional stations were established. Twenty stations on the Missouri River and one station on each of the major tributaries were sampled. Stations are designated as river miles measured upstream from the Missouri River confluence with the Mississippi River (Table B1).

Channelization and a shifting sand bottom have restricted bottom animals to pile dikes and adjacent backwater areas. Pile dikes were examined to determine the representative kinds of benthic animals inhabiting a reach of river. Backwater areas were sampled for bottom organisms with either a Petersen or Ekman dredge. Dredgings were washed and strained through a U. S. Standard No. 30 sieve, and organisms remaining in the sieve were preserved for laboratory identification.

Suspended algal (phytoplankton) samples of one liter were collected at pre-determined sampling stations and were preserved with five percent formalin for later identification.

This survey was conducted by aquatic biologists from the Missouri River Basin and Technical Advisory and Investigations Branch, Federal Water Pollution Control Administration. The report was written by Messrs. Delbert Hicks, Loys Parrish and Steve Bugbee.

BOTTOM ANIMALS

Many invertebrate animals are found living on the beds of rivers. In a clean water environment, this community includes numerous kinds of pollution sensitive animals which serve as food organisms for desirable game fish. Pollution tolerant organisms are present but are few in number. As the environment receives increasing amounts of organic wastes, clean water animals are reduced or eliminated from the community in the order of their sensitivity to resultant water quality. This adverse change in the bottom associated community is indicative of the extent of pollution. Further evidence of organic pollution is indicated by increases in floating solids and in formation of sludge deposits that may undergo rapid decomposition that produces sulfide, methane and other gases, and reduces dissolved oxygen in the water.

The river upstream from Sioux City (river mile 736) and downstream to Omaha City (river mile 601) supported a stream bed animal community indicative of unpolluted water. Clean-water stoneflies, mayflies, and caddisflies were the predominant kinds of bottom organisms throughout most of this reach. The number of pollution tolerant forms remained proportionately lower than sensitive kinds except in the reach bordered by Sioux City, Iowa, and Dakota City, Nebraska, river mile 730 (Figures B2 & B3). Here degradation was from inadequately treated wastewater. Floating solids consisting of manure, chopped garbage and similar materials were observed. These were found upstream from the municipal waste treatment plants, thus, they originate from untreated wastes. The Big Sioux River contained 4 kinds of pollution tolerant animals, but only 1 sensitive form, and the bottom contained deposits of organic material and oil thus typifying water of poor quality.

The bottom of the Floyd River was covered with organic solids and manure that exuded the rotten egg odor of hydrogen sulfide. Water quality was degraded so severely that most tolerant bottom animals could not inhabit these waters. Downstream at river mile 664, Soldier Creek (Iowa) discharged degraded water to the Missouri River. The creek supported 2 kinds of pollution tolerant bottom organisms and no clean water kinds (Table B2) an indication that the creek was polluted. The sandy bottom of the Boyer River (Iowa), river mile 635, supported only one kind of sensitive clean-water bottom organism and three kinds of tolerant bottom organisms (Table B2). Water from this stream was moderately degraded. Flows from both streams were low in volume and degraded water discharging from these streams had no observable effect on the Missouri.

Downstream from Omaha, Nebraska, and Council Bluffs, Iowa, adverse effects of discharged wastes were discernible for more than 166 miles. Floating solids were evident; unsightly globular masses of grease, chunks of animal fat, and paunch manure accumulated in eddy areas. Grease-balls were observed in the reach of river extending from downstream of Omaha, Nebraska, and Council Bluffs, Iowa, to past the St. Joseph, Missouri, water supply intake. Clean-water animals were destroyed for a distance of 54 miles downstream to river mile 547, except at Bartlett, Iowa (river mile 581) where an aberrant increase in kinds of sensitive and tolerant forms occurred (Figure B3). Available information indicates that the animals found here were temporary inhabitants of this reach of river. The Platte River enters upstream and during the survey was swollen by rains that washed Platte River invertebrates into the Missouri River. The community found at river mile 581 was composed of nearly the same kinds as found in the Platte River. These particular forms found in the Missouri River would be temporary inhabitants until sufficient time had passed for the pollutants to destroy or drive them from the area.

Downstream from Brownville, Nebraska (river mile 525), the number of sensitive kinds of bottom animals were proportionately greater than pollution tolerant animals (Figure B2). This increase resulted from water quality improvement through natural purification of the wastes from the vicinity of Omaha, Nebraska. The river continued to support a community of benthic animals indicative of good quality water downstream to St. Joseph, Missouri. The slowly decomposing grease globs remaining in these waters did not induce changes sufficient to affect the aquatic life but they were aesthetically objectionable for recreation and in community water supplies.

SUSPENDED ALGAE

The phytoplankton (suspended algal community) in large flowing streams originates in lakes and backwaters associated with the streams. This community is affected by environmental factors characteristic to each stream such as: turbidity, water velocity, and available nutrients. Turbidity restricts the amount of light that penetrates the water and thus restricts algal photosynthesis, which is necessary for food production.

Water velocity affects suspended algae (phytoplankton). Phytoplankton are principally static water organisms and their presence in flowing water results from facultative adaptations. Swift turbulent currents are detrimental to many of these fragile organisms because of molar action from suspended solids and by preventing the organism from maintaining a position for optimum light. In the Missouri River, a swift current, high turbidity, and lack of adjoining still water environments (due to channelization of the river) tend to limit the phytoplankton community to low numbers except when nutrients are discharged to the river.

Nutrients produce changes in numbers and kinds of algae. Increased quantities of nutrients discharged to a stream produce an increase in numbers of algal cells unless physical factors are limiting.

Suspended algae ranged in numbers from 870 cells per milliliter (ml) to 1,000 cells per ml in the river reach from Sioux City, Iowa to Omaha, Nebraska and Council Bluffs, Iowa (Figure B4 Table B3). Downstream from Omaha and Council Bluffs (river mile 601), the algal population increased almost six fold to a high of 6,000 cells per ml at river mile 560. This was the result of nutrients being discharged to the river. Downstream from this point to St. Joseph, Mo. (river mile 450), the population of algae gradually declined.

Most of the tributary streams contained high populations of phytoplankton but the stream flows were too small to contribute significant quantities of algae to Missouri River algal populations.

In the reach of the Missouri River surveyed, there were no nuisance conditions or problems created by algae. The algal population downstream from Omaha, Nebraska, was predominately diatoms which in some waters have been known to contribute to water supply filter clogging problems. However, in the Missouri River, the high concentrations of suspended solids and resultant filtering problems minimize effects from the algal population.

Table B1. Station Descriptions

Missouri River Basin Survey

Missouri Riv. Mi.	Description
736.0	Missouri R. 2 mi. above confluence (at I-29 Hwy. bridge)
734.0-1.0	Big Sioux River.
731.0-0.01	Floyd River
730.0	Missouri R. below Floyd R. confluence--Sioux City, Ia. (at power cable X-ing).
717.4	Missouri R. below Sioux City STP outfall (at power cable X-ing).
699.5	Missouri R. at Lighthouse Marina (also called Don Ruth Marina, 6 mi. from Whiting, Ia.)
676.5	Missouri R. (at Upper Sioux Reach upper light - left bank).
664.0-1.0	Soldier R.
654.6	Missouri R. above Blair, Neb. (at Tyson Boat Marina 0.2 mi. above light - right bank).
635.1-3.0	Boyer River.
626.2	Missouri R. at Omaha Waterworks intake (0.3 mi. below Hwy. 36 bridge).
618.3	Missouri R. at I. C. RR bridge.
610.5	Missouri R. below Omaha STP outfall (at power cable X-ing).
601.3	Missouri R. at Bellevue, Neb. (0.1 mi. below St. Hwy. 370 bridge).
594.8-0.5	Platte R.
591.2	Missouri R. at Plattsmouth, Neb. (0.2 mi. below Pollock light - right bank).
580.9	Missouri R. at Bartlett, Iowa (at Shenandoah Boat Club ramp).
559.7	Missouri R. below Nebraska City (0.2 mi. above Fraziers light - left bank).
546.7	Missouri R. at Peru Sportsman's Club ramp (0.2 mi. above Barney Bend light - right bank).
525.1	Missouri R. at boat landing (at Morgan Bend, upper light - left bank).
507.5	Missouri R. 9.5 mi. above Rulo, Neb. (at landing 0.2 mi. below light - left bank).
488.3	Missouri R. at White Cloud, Kan. (at power cable X-ing).
469.0	Missouri R. 0.5 mi. above Charleston landing (Baymark - left bank).
452.3	Missouri R. at St. Joseph Waterworks intake (0.3 mi. below Baymark - right bank).

Table B2. Bottom Associated Animals Collected from

Missouri River, October 1968

Organism	Station (River Mile) 736	730	717	699	676	655	626	618	Big Sioux River 734-1	Floyd River 731-.01	Soldier Creek 664-1	Boyer River 635-3
Sensitive Organisms												
Stoneflies												
Perlodidae	-	-	-	-	Q	-	-	-	-	-	-	-
Acroneuria	-	-	-	Q	-	Q	-	-	-	-	-	-
Mayflies												
Ameletus	-	-	-	-	-	Q	Q	-	-	-	-	4
Caenis	-	-	-	-	-	-	-	Q	-	-	-	-
Heptagenia	-	-	Q	Q	-	Q	Q	Q	-	-	-	-
Hexagenia	-	-	-	Q	-	-	-	-	-	-	-	-
Isonychia	Q	Q	Q	Q	Q	Q	-	-	-	-	-	-
Stenonema	Q	-	Q	Q	Q	Q	-	Q	-	-	-	-
Tricorythodes	-	-	-	-	-	-	-	Q	-	-	-	-
Caddisflies												
Cheumatopsyche	-	-	-	-	-	Q	-	-	-	-	-	-
Hydropsyche	Q	Q	Q	Q	Q	Q	Q	Q	Q	-	-	-
Neureclipsis	Q	Q	Q	Q	-	Q	Q	Q	-	-	-	-
Potamyia	-	-	-	-	Q	-	-	-	-	-	-	-
Psychomyia	-	-	-	-	Q	-	-	-	-	-	-	-
Subtotal/sq. ft.	4	3	5	7	6	8	4	6	1	0	0	4
Subtotal/kinds	4	3	5	7	6	8	4	6	1	0	0	1
Intermediate Organisms												
Midges												
Cricotopus	-	Q	-	Q	-	-	Q	Q	-	-	-	-
Glyptotendipes	Q	-	Q	-	-	-	-	-	Q	-	Q	-
Orthocladius	-	-	-	-	-	Q	-	-	-	-	-	-
Polypedilum	-	-	-	-	-	Q	Q	Q	-	-	8	Q
Procladius	-	-	-	-	-	-	Q	-	-	-	-	-
Psectrocladius	-	Q	-	-	-	-	-	Q	-	-	Q	-
Pseudochironomus	-	-	-	-	-	-	-	-	-	-	Q	-
Tanytarsus	-	-	-	-	-	-	-	Q	-	-	-	-
Craneflies												
Erioptera	-	-	-	-	-	-	-	-	-	-	-	Q
Blackflies												
Simulium	-	-	-	-	-	-	-	-	-	-	Q	-
Damselflies												
Amphiagrion	-	-	-	-	-	-	-	-	-	-	Q	-
Argia	-	-	-	-	-	Q	-	-	-	-	Q	-
Scuds												
Gammarus	-	Q	-	-	-	-	-	-	-	-	-	Q
Hyalella	Q	-	-	-	Q	Q	-	Q	Q	-	-	Q
Limpets												
Ancylidae	-	-	-	-	-	-	-	-	-	-	Q	Q
Clams												
Sphaeriidae	-	-	-	-	-	-	-	-	-	-	4	-
Sow Bugs												
Asellus	-	Q	Q	Q	Q	Q	-	-	-	-	-	-
Subtotal/sq. ft.	2	4	2	2	2	5	3	5	2	0	19	5
Subtotal/kinds	2	4	2	2	2	5	3	5	2	0	9	5
Tolerant Organisms												
Snails												
Physa	-	Q	Q	Q	Q	-	-	Q	Q	-	-	-
Leeches												
Hirudidae	Q	-	Q	Q	Q	Q	Q	-	Q	-	-	Q
Bloodworms												
Chironomus	Q	Q	Q	Q	Q	-	Q	-	Q	-	4	Q
Sludgeworms												
Tubificidae	Q	4	-	Q	-	-	-	Q	280	6	8	304
Subtotal/sq. ft.	3	6	3	4	3	1	2	2	283	6	12	306
Subtotal/kinds	3	3	3	4	3	1	2	2	4	1	2	3
Grand Total/sq. ft.	9	13	10	13	11	14	9	13	286	6	31	315
Number of Kinds	9	10	10	13	11	14	9	13	7	1	11	9

Q = Organisms collected qualitatively, arbitrarily given value of one for computing numbers per square foot.

Table [illegible]2 Cont. Bottom Associated Animals Collected from

Missouri River, October 1968

Organisms	Station (River Mile) 610	601	591	581	560	547	525	507	488	469	452	Platte River 595-.5
						Sensitive Organisms						
Mayflies												
Ameletus	Q	-	-	Q	-	-	-	-	-	Q	Q	-
Baetis	-	-	-	-	-	-	-	-	-	-	-	-
Heptagenia	-	-	-	Q	-	-	-	Q	-	Q	Q	Q
Isonychia	-	-	-	Q	-	-	-	-	-	-	-	-
Stenonema	Q	-	-	Q	Q	-	Q	Q	Q	Q	Q	Q
Caddisflies												
Cheumatopsyche	Q	Q	-	-	-	-	Q	-	2	Q	-	Q
Hydropsyche	-	-	-	Q	-	-	-	Q	-	Q	-	Q
Neureclipsis	-	-	-	-	-	-	Q	-	-	Q	Q	-
Subtotal/sq. ft.	3	1	0	5	1	0	3	3	3	6	4	4
Subtotal Kinds	3	1	0	5	1	0	3	3	2	6	4	4
						Intermediate Organisms						
Beetles												
Cymbiodyta	-	-	Q	-	-	-	-	-	-	-	-	-
Midges												
Cardiocladius	-	Q	-	-	-	-	-	-	-	Q	Q	-
Chironomus	-	-	-	-	-	-	-	-	2	-	-	-
Clinotanypus	-	Q	-	-	-	-	-	-	-	-	-	-
Cricotopus	Q	Q	-	-	-	-	-	-	-	Q	Q	-
Glyptotendipes	-	-	-	-	-	-	-	Q	-	-	-	-
Orthocladius	-	-	-	-	-	-	-	-	-	-	-	-
Pentaneura	-	-	-	-	Q	-	-	-	-	Q	Q	-
Polypedilum	Q	4	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
Procladius	-	Q	-	Q	-	-	-	-	-	-	-	Q
Psectrocladius	-	Q	-	Q	-	-	Q	-	-	-	-	-
Spaniotoma	Q	Q	-	-	Q	-	Q	-	Q	Q	Q	-
Tanytarsus	Q	Q	-	-	-	-	Q	-	-	Q	-	Q
Tanypus	-	-	-	-	-	-	-	4	-	-	-	-
Psectrotanypus	-	-	-	Q	-	-	-	-	-	-	-	-
Craneflies												
Erioptera	-	-	-	-	-	-	-	-	-	-	Q	-
Limonia	-	-	-	-	-	-	Q	-	-	-	-	-
Blackflies												
Simulium	-	-	-	-	-	-	-	-	-	-	-	Q
Damselflies												
Amphiagrion	-	-	-	Q	-	-	-	-	-	-	-	-
Argia	-	-	-	Q	-	-	-	Q	-	-	Q	-
Scuds												
Crangonys	-	-	-	-	Q	-	Q	-	Q	Q	-	-
Gammarus	-	-	-	Q	-	-	-	-	-	-	-	-
Hyalella	-	-	Q	-	Q	Q	-	Q	-	Q	Q	-
Sow Bugs												
Asellus	-	Q	-	-	-	-	-	Q	-	Q	-	-
Limpet												
Ancylidae	-	-	-	-	-	-	-	-	-	-	-	-
Subtotal/sq. ft.	4	12	3	7	5	2	6	9	5	9	8	9
Subtotal Kinds	4	9	3	7	5	2	6	6	4	9	8	4
						Tolerant Organisms						
Snails												
Physa	-	Q	Q	Q	Q	-	-	-	-	-	Q	-
Leeches												
Hirudidae	Q	Q	-	Q	-	-	Q	-	-	Q	-	Q
Bloodworms												
Chironomus	-	-	-	Q	-	-	-	Q	-	8	-	-
Sludgeworms												
Tubificidae	Q	190	100	Q	200	180	320	120	90	580	Q	Q
Subtotal/sq. ft.	2	192	101	4	201	180	321	121	90	589	2	2
Subtotal Kinds	2	3	2	4	2	1	2	2	1	3	2	2
Grand Total/sq.ft.	9	204	104	16	207	182	330	133	98	604	12	10
Number of Kinds	9	13	5	16	8	3	11	11	7	18	14	10

Q = Organisms collected qualitatively, arbitrarily given value of one for computing numbers per square foot.

Table B3. Suspended Algae, Missouri River Survey, October - November, 1968

River Mile	Number/ml	Volume (ppm)
736	872	0.84
734-1.0	11,653	11.75
730	728	1.34
717	339	1.01
699	749	1.24
676	687	0.93
664-1.0	644	0.61
655	893	1.54
635-3.0	961	0.88
626	966	1.85
618	996	2.28
610	453	0.65
601	817	5.44
595-0.5	9,236	13.04
591	947	1.92
581	1,654	2.17
560	5,995	5.82
547	3,791	3.53
525	2,584	2.51
507	3,046	2.93
488	1,769	2.63
469	1,905	3.51
452	1,366	1.85

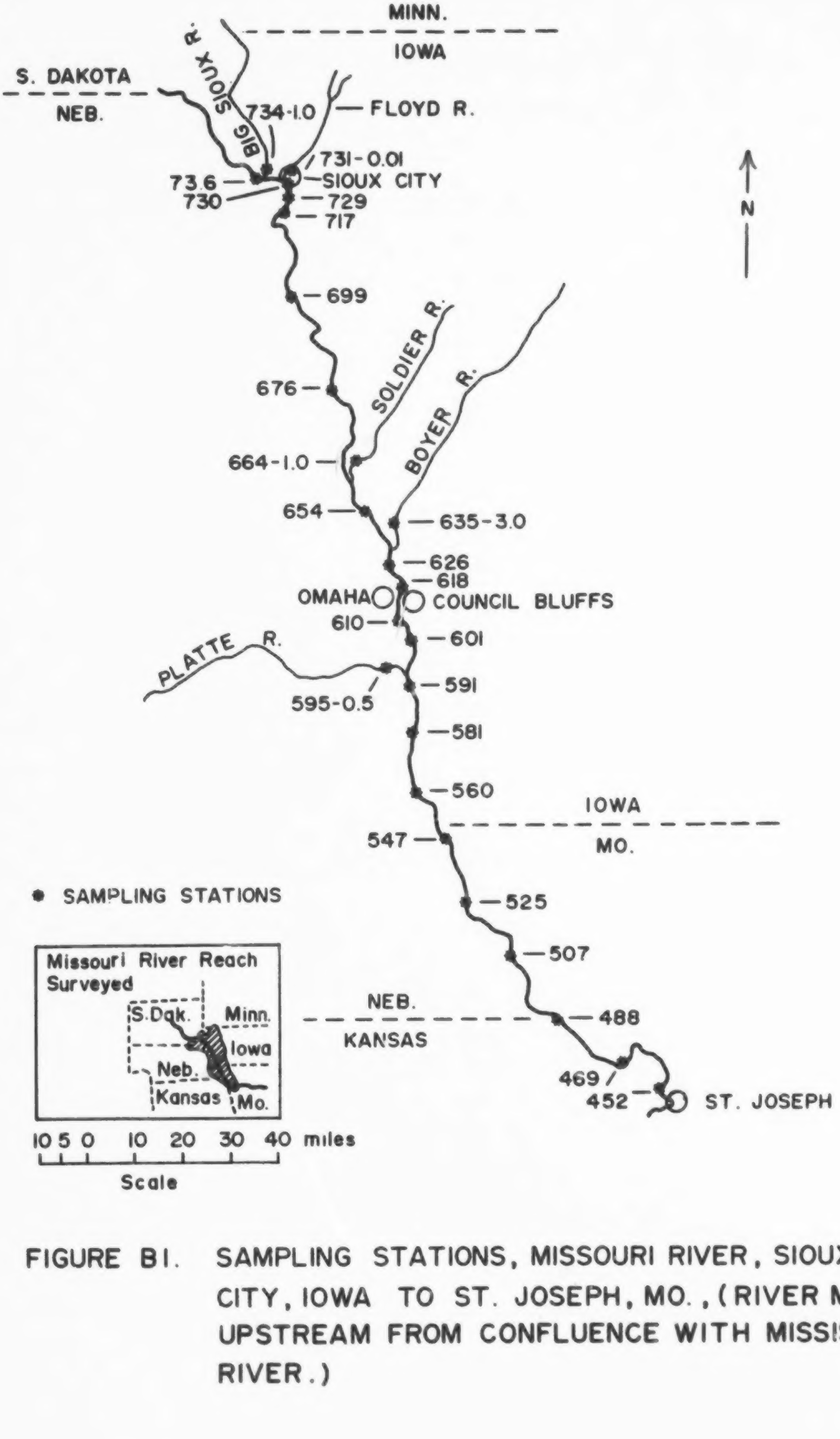

MINN.
IOWA
S. DAKOTA
NEB.
BIG SIOUX R.
734-1.0
FLOYD R.
731-0.01
SIOUX CITY
73.6
730
729
717
699
SOLDIER R.
BOYER R.
676
664-1.0
654
635-3.0
626
618
OMAHA
COUNCIL BLUFFS
610
601
PLATTE R.
595-0.5
591
581
560
IOWA
MO.
547
525
507
NEB.
KANSAS
488
469
452
ST. JOSEPH
N
● SAMPLING STATIONS
Missouri River Reach Surveyed
S.Dak.
Minn.
Iowa
Neb.
Kansas
Mo.
10 5 0 10 20 30 40 miles
Scale

FIGURE B1. SAMPLING STATIONS, MISSOURI RIVER, SIOUX CITY, IOWA TO ST. JOSEPH, MO., (RIVER MILES UPSTREAM FROM CONFLUENCE WITH MISSISSIPPI RIVER.)

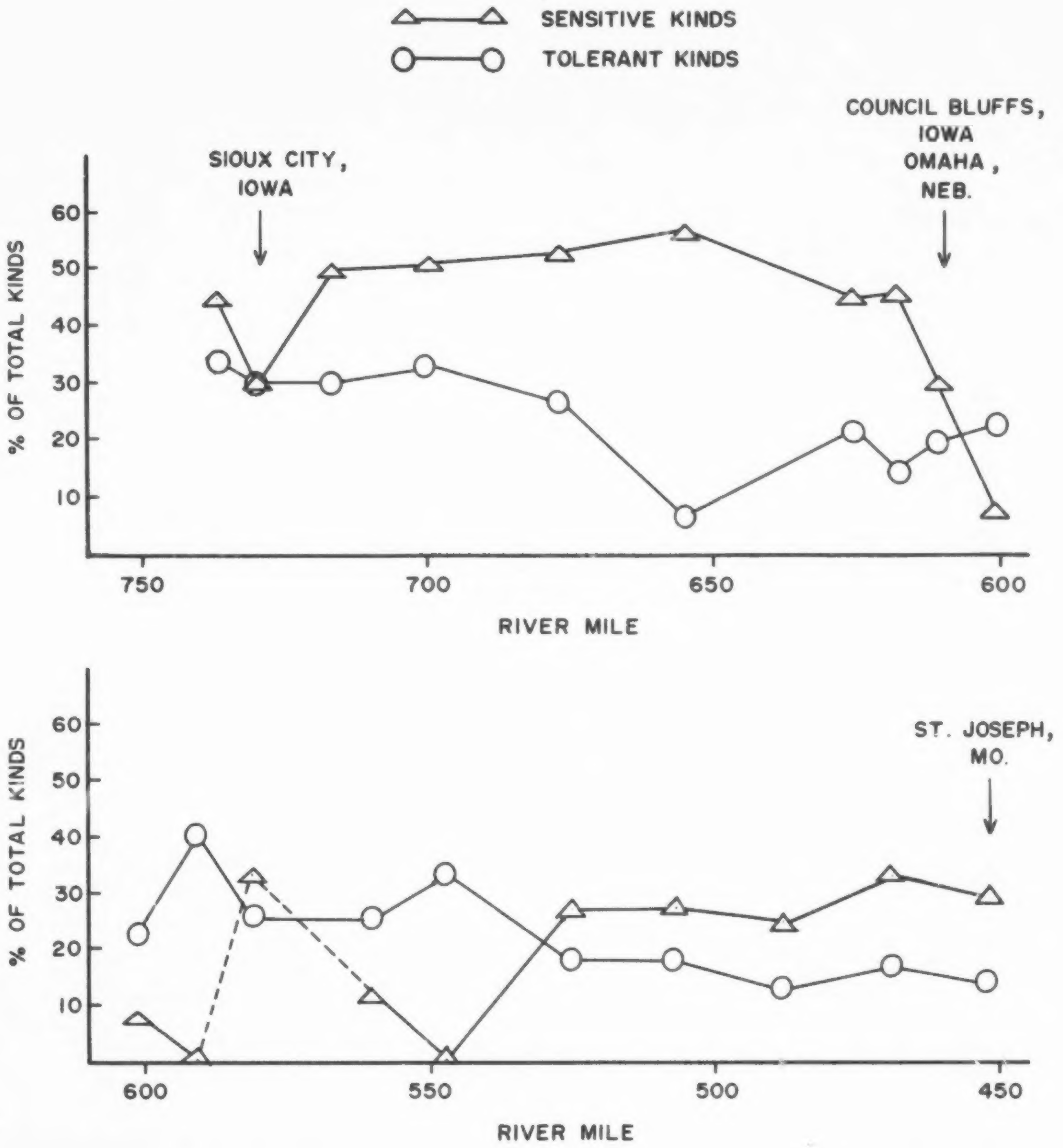


FIGURE B2. RELATIVE NUMBER OF POLLUTION SENSITIVE AND TOLERANT KINDS OF ORGANISMS IN THE MISSOURI RIVER SURVEY, SIOUX CITY, IOWA TO ST. JOSEPH, MO., OCTOBER, 1968.

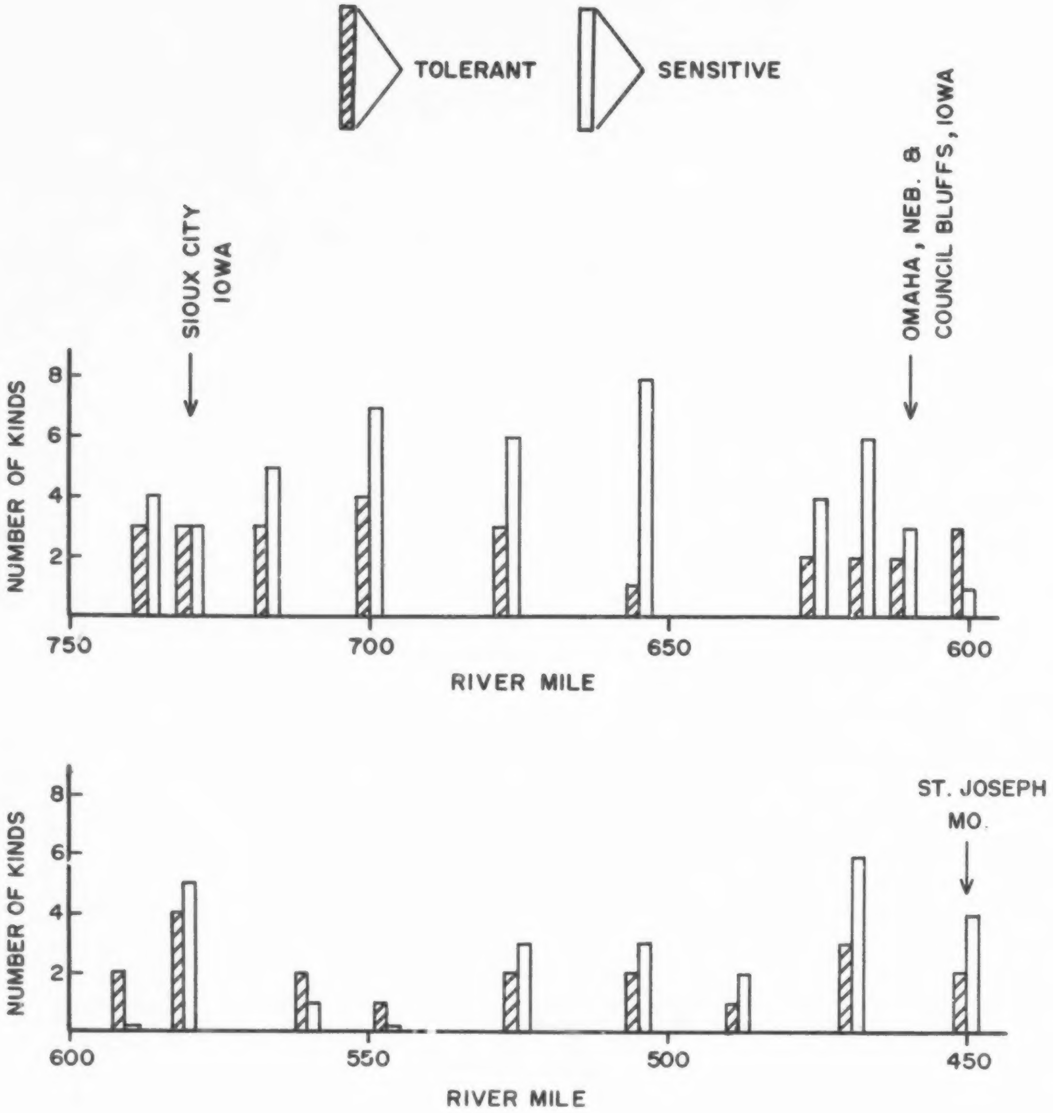


FIGURE B3. NUMBER OF KINDS OF BOTTOM ORGANISMS, MISSOURI RIVER SURVEY, SIOUX CITY, IOWA – ST. JOSEPH, MO. OCTOBER, 1968.

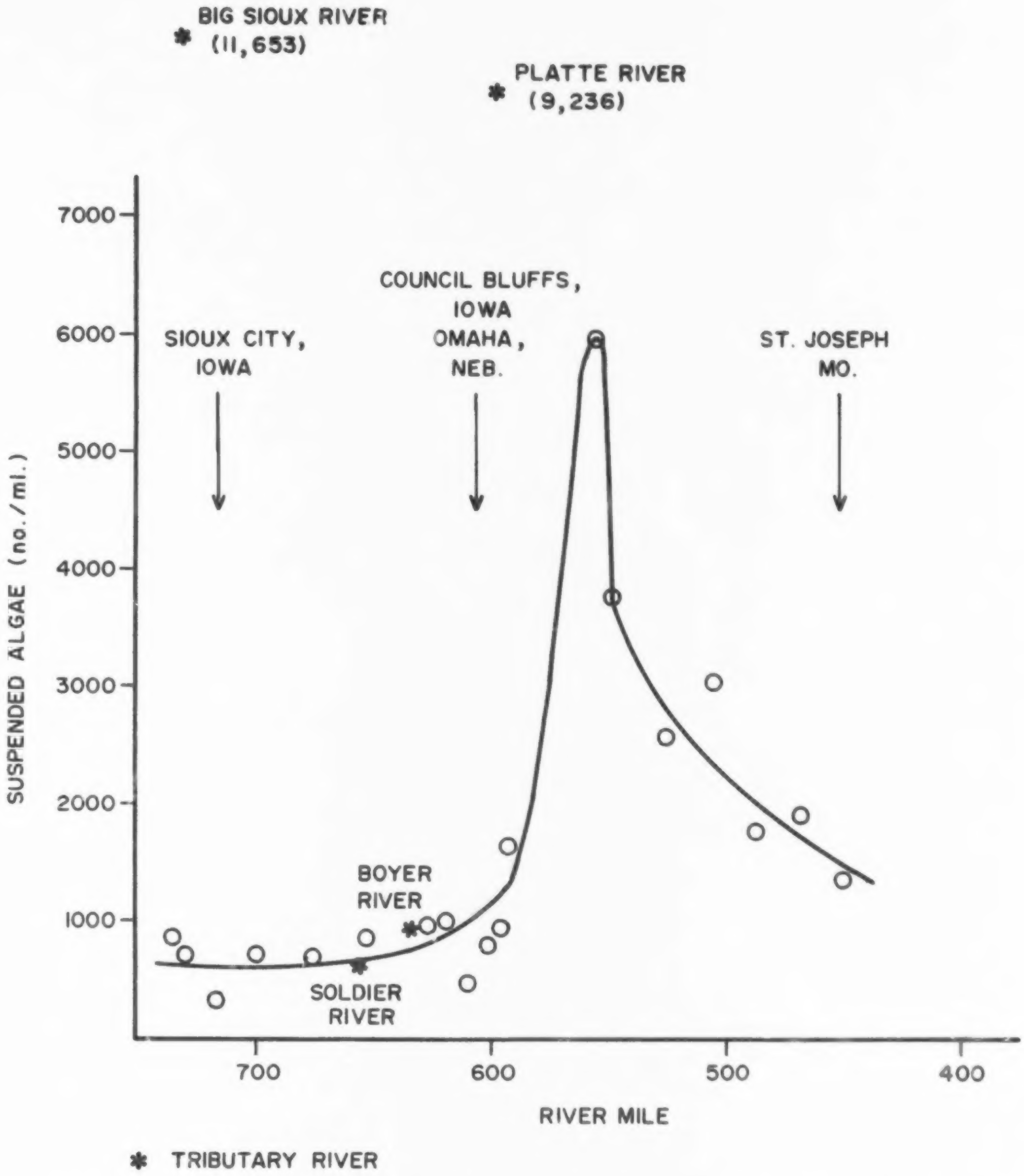


FIGURE B4. SUSPENDED ALGAE (number/ml.), MISSOURI RIVER, OCTOBER - NOVEMBER, 1968.

APPENDIX C

OUTDOOR RECREATION AND WATER POLLUTION IN WESTERN IOWA AND ALONG THE MISSOURI RIVER

TABLE OF CONTENTS

Page

SUMMARY.. 1

INTRODUCTION... 2

THE OUTDOOR RECREATION RESOURCES REVIEW COMMISSION REPORT........... 5

OUTDOOR RECREATION TRENDS.. 8

LEWIS AND CLARK TRAIL.. 9

MISSOURI BASIN INTER-AGENCY COMPREHENSIVE BASIN PLANNING............ 12

OUTDOOR RECREATION IN IOWA....................................... 17

THE MIDDLE MISSOURI.. 23

CONCLUSION... 24

APPENDIX A

APPENDIX B

APPENDIX C

APPENDIX D

SUMMARY

Both the Federal and State Governments concur that western Iowa and the Missouri River have existing recreation deficiencies, much of which is associated with water-oriented activities. This is documented in the recreation plans, studies, and reports which were reviewed in the preparation of this statement.

Because of projected increases in population, leisure time, disposable income and mobility, and a greater interest in outdoor recreation, the demand for recreation resources and facilities is expected to surge upward.

While the area under review is not richly endowed with pristine wilderness conditions, extensive forests, mountains, clear trout streams, or other outstanding scenic attractions, there are opportunities available to satisfy this latent recreation demand.

Among the key recreation potentials in proximity to the population concentration is the Missouri River, its Oxbow Lakes, and the lands immediately adjoining them.

Outdoor recreational opportunities along the Missouri River are now recognized as a national resource worthy of development to a far greater degree than heretofore. This gained national significance in 1964 when Congress established the Lewis and Clark Trail Commission. The Commission's purpose was to advise and stimulate the activities of all levels of government and the private sector to create an appreciation of the resources, encourage their conservation, and to promote the protection and development of outdoor recreation resources along the route for public use and enjoyment.

The National Commission, in association with the Iowa State Lewis and Clark Trail Committee, is now implementing the recommendations contained in the Commission's interim report. Among the problems confronting full attainment of the recognized goals is water pollution. The Commission specifically recommends that the FWPCA and HEW should give continuing attention to the abatement and control of water pollution along the trail route. Also, that States take steps to strengthen measures to reduce water and air pollution along the trail.

Raw or treated wastes which are discharged into these waters which will produce putrescent or otherwise objectionable sludge deposits, floating debris, scum, odors, color, chemical concentrations, etc., are detrimental to outdoor recreation use and enjoyment. This is true whether it involves a direct contact sport like fishing, boating, or water skiing, or a secondary activity like sightseeing, camping, or picnicking.

The Nation, Iowa, or parts thereof do not have unlimited recreation resources. Each segment of real estate is at a premium and must be managed under the highest conservation principles attainable. Thus, each contribution, whether it be large or small--such as secondary waste treatment instead of primary, is important to satisfying recreational demands in a quality environment. It would be inimical to the development of effective pollution abatement goals and water quality enhancement measures if the only course of action to be taken is no action at all.

INTRODUCTION

Demands for outdoor recreation are increasing throughout the Nation due in large measure to the population explosion, more leisure time, greater disposable incomes, and a highly improved mobility. Thus, as never before, people are taking to the out-of-doors in numbers that far exceed any previous estimates. The Bureau of Outdoor Recreation has stated in its

Outdoor Recreation trends report of April 1967 that--our steadily increasing participation in outdoor activities has amazed observers for the past 25 years, and never more so than now. It further adds that--our outdoor recreation demands have become imperative.

Unfortunately, the places to go, or the supply of recreation opportunities, are not keeping pace with the snowballing demand. It must be said that this situation exists today in Iowa as well as in other portions of the country. But, in this context, Iowa is somewhat unique in that it has been less favorably endowed with an abundance of natural resources. Also, percentagewise, there is less area owned in Iowa by the State and Federal Governments than any State in the Union. Space, then becomes a major problem. Thus, it finds itself less able to cope with the imbalance of supply and demand. This is especially true for the western portion of Iowa. This area lacks the pristine wilderness conditions, mountains, extensive forests, clear trout streams, and the outstanding scenic attractions found elsewhere in the Nation. To be sure, this western portion of Iowa is not, at present, especially conducive to participating in outdoor recreation activities. Basically, it is farm country where the greatest percentage of outdoor recreation opportunities are man-made, i.e., reservoirs, swimming pools, golf courses, city park facilities, etc.

Inasmuch as the supply of recreation lands and facilities are limited, and natural resources are at a premium, it is paramount that every effort be made to capitalize on the remaining opportunities available and to sustain them at the highest degree of quality attainable. This includes the Missouri River, its tributaries, and the immediate environment.

In focusing on the supply of existing facilities and the recreational potential, perhaps it would be best to do so by briefly summarizing pertinent conclusions and recommendations from various reports, studies, and plans having implications on the area under review. For recreation purposes, the "area under review" is limited to those Iowa counties which drain into the Missouri River.

THE OUTDOOR RECREATION RESOURCES REVIEW COMMISSION REPORT

First, the bipartisan "bible of outdoor recreation" prepared in 1962 by the Outdoor Recreation Resources Review Commission, entitled Outdoor Recreation for America, clearly portrayed the intimate relationship of water and water pollution to outdoor recreation. Following are some key quotes which depict a conservation philosphy for managing water for recreation. A philosphy which is still considered accurate, and the underlying factor for many of the programs taken and/or proposed in the country today--Federal, State, local, and private.

Page 4 - Water is a focal point of outdoor recreation--"Most people seeking outdoor recreation want water--to sit by, to swim and fish in, to ski across, to dive under, and to run their boats over. Swimming is now one of the most popular outdoor activities and is likely to be the most popular of all by the turn of the century. Boating and fishing are among the top 10 activities. Camping, picnicking, and hiking, also are high on the list and are more attractive near water sites."

Page 87 - "Urban or rural, water is a magnet. Wherever they live, people show a strong urge for water-oriented recreation. There are many other reasons for water resource programs, and recreation use often is incidental or unplanned. To say this, however, is to note how great are the opportunities." . . . . In most major cities, pollution has destroyed valuable recreation opportunities, just where they are needed most. As a sanitation measure alone, the abatement of pollution is a necessity; inherently, it is also one of the best means of increasing recreation opportunities."

The ORRRC report also described the importance and key role of the state governments. On Page 137 it was stated that--In a national effort to improve outdoor recreation opportunities, state governments should play the pivotal role. They are more advantageously situated than either local units or the Federal Government to deal with many current recreation problems. States have direct experience in shaping programs to meet varying conditions and particular needs of their citizens. And, they have the necessary legal authority. Moreover, the States occupy a key position--the middle level in our complex system of government. They deal with other States, work with a great variety of agencies at the national level, and are responsible for guiding and assisting all the political subdivisions within the State-villages, cities, towns, counties, and metropolitan regions. Since other responsibilities that affect outdoor recreation opportunities, such as highway construction and the management of forest, wildlife, and water resources, are also generally focused at this level, the State government can make sure that these programs are in harmony with its recreation objectives.

On Page 173, the importance of water itself was discussed as well as its relationship to recreation. The following three paragraphs state that--Water is a prime factor in most outdoor recreation activities. The Commission's National Recreation Survey reports that 44 percent of the population prefer water-based recreation activities over any others. Water also enhances recreation on land. Choice camping sites and picnic areas are usually those adjacent to or within sight of a lake or stream, and the touch of variety added by a pond or marsh enriches the pleasures of hiking or nature study.

Recreation on the water is increasing. This trend is likely to continue as more young people acquire an interest in water sports, new reservoirs are constructed, the boating industry wins new converts, and relatively new forms of water-based recreation, such as skindiving and water skiing, become increasingly popular. The trend will be greatly accelerated if pollution control programs are successful in cleaning up streams, lakes, and seashore areas that are presently off limits for recreation, or are now so unattractive as to preclude many activities.

As the population grows and interest in water-based recreation increases, the already heavy recreation pressures on water resourses will reach critical proportions. The problems stemming from this pressure are among the most difficult in the entire outdoor recreation field.

On Page 174, the importance of water suitability for recreational purposes was again mentioned. It stated that--Limitations upon public access and poor quality are serious problems in many places. Public policy at all levels of government should be directed toward eliminating these barriers to outdoor recreation.

Page 176 states that--Existing treatment facilities and practices are often inadequate to maintain the quality of water for recreation purposes. . . . . Recreation should be recognized as a motivating purpose in programs and projects for pollution control and as a necessary objective in the allocation of funds therefore!

OUTDOOR RECREATION TRENDS

The Bureau of Outdoor Recreation updated the ORRRC's recreation demand study and published its findings in Outdoor Recreation Trends. Basically, it reiterated and emphasized the fact that every recreation activity involving water will be sought in ever-increasing quantities in future years. The following table demonstrates this point quite vividly:

THE MOST POPULAR WATER RELATED RECREATION ACTIVITIES IN AMERICA

Major Type	1965 Overall Ranking	1965 Occasions of Participation (Millions)	1980 Overall Ranking	1980 Occasions of Participation (Millions)	1980 Percent Increase
Swimming	2nd	970	1st	1,671	72
Fishing	8th	322	8th	422	31
Boating*	10th	220	9th	387	76
Water Skiing	14th	56	13th	124	121

*Other than canoeing and sailing

LEWIS AND CLARK TRAIL

One of the most noteworthy events along the Missouri River is the reconstruction of Lewis and Clark Expedition of 1804-06. It has been stated that historians have since come to consider this Expedition as one of the most important events in the development of the western United States. Economically, it provided the first knowledge of the vast resources and eventually led to the opening of the western lands for development and settlement. Politically, it secured the 1803 American purchase of the Louisiana Territory and extended American claims to the Pacific.

On October 6, 1964, the 28-member Lewis and Clark Trail Commission (L&CC) was established for the promotion and development in reconstructing the Lewis and Clark Trail. Included in the membership was Iowa's Governor, Harold E. Hughes. Congress directed the Commission to--promote public awareness of the historic significance of the Expedition, to create an appreciation of the resources of the regions through which the Expedition passed, to encourage the conservation of natural resources, and to promote the protection and development of outdoor recreation resources along the route for public use and enjoyment.

The Act itself (PL 88-630) reads in part--that the route traversed by Captains Meriwether Lewis and William Clark . . . be kept available for the inspiration and enjoyment of the American people . . . and thereby to encourage desirable long-term conservation objectives in the public interest of the people of that region and the Nation as well as the public use and outdoor recreation benefits therefrom.

The following are a number of excerpts taken from the Lewis and Clark Trail-Interim Report of October 1966:

Page 1 - The Lewis and Clark Trail Commission's program for development of the Trail proposes that many and varied resources be linked in several ways for public use and enjoyment. Visitors may travel by boat on natural water courses or on man-made lakes along a portion of the route on the Missouri and its tributaries. Listed among the purposes of the Commission were to (1) create an appreciation of the resources of the regions through which the expedition passed; (2) encourage the conservation of natural resource; and (3) promote the protection and development of outdoor recreation resources along the route for public use and enjoyment.

Page 5 - Among the problems confronting the L&CC were (1) growing population is using up areas of natural beauty for living space and demanding more areas of natural beauty for playing space; and (2) uncontrolled dumping of waste products is polluting streams and making natural resources unusable.

Page 5 - The L&CC makes a recommendation that the FWPCA and HEW should give continuing attention to the abatement and control of air and water pollution along the Lewis and Clark Trail.

Page 6 - The L&CC makes a recommendation that where needed State legislation should be enacted and enforced to control water pollution along the Lewis and Clark Trail.

Page 8 - Resolutions adopted by the L&CC direct the Secretaries of Health, Education, and Welfare and HUD accelerate measures to control pollution of the Missouri. Also, that BOR encourage States along the Lewis and Clark Trail to include in Statewide outdoor recreation plans required by the Land and Water Conservation Fund Act of 1965 suitable outdoor recreation developments as recommended by the LC study report. Further it recommended that States appoint Lewis and Clark Trail Committees to carry out the purposes of the National Commission. Among other things it encourages States to take steps to strengthen State measures to reduce water pollution along the Missouri trail. In Iowa, a 7-man State committee was created by Governor Hughes on February 3, 1966. This Committee is working with all governmental agencies involved to plan development for the Trail. Apparently, location of the trail has been identified and marked to date.

Page 12 - It proposed that 35 recreation sites be built by the Corps of Engineers along the Missouri River from Sioux City, Iowa, to Rulo, Nebraska. (The Iowa L&CC concurred in this recommendation.)

Page 13 - Planned development of camping facilities and eight river accesses on the Missouri to accommodate large pleasure boats.

It should be pointed out that the Commission's resolutions for recreational development of the Missouri River were adopted after the Commission accepted a detailed plan for the protection and development of the Lewis and Clark Trail which had been prepared by the Bureau of Outdoor Recreation. The BOR's plan is entitled "The Lewis and Clark Trail - A Proposal for Development." In addition, it should be pointed out that the Corps of Engineers prepared a publication entitled Recreation Aspects of the Lower Missouri River in conjunction with the Lewis and Clark Trail in January 1968. This document lists the major historic, wildlife, and recreational areas, both existing and proposed along the Missouri River in Iowa. Maps are utilized in identifying the locations of these recreation resources.

MISSOURI BASIN INTER-AGENCY COMPREHENSIVE BASIN PLANNING

The Bureau of Outdoor Recreation prepared a preliminary report entitled *Outdoor Recreation in the Middle Missouri Tributaries Subregion* as part of its contribution to the Missouri River Basin Comprehensive Framework Study. This report which centers on western Iowa provides one of the best analysis of recreation needs and potential in the area under review. The major conclusions and recommendations are extracted as follows:

Page 17 - *Other factors expected to influence and increase future recreation demand includes: (1) greater interest in the Missouri River as a play area as pollution and siltation control result in clearer and cleaner waters and (2) greater interest in and use of the Missouri River as the Lewis and Clark Trail plans are completed*.

On Page 23, it is stated that--the needs for additional water now and in the future appear to be greatest in the area influenced by Omaha, Council Bluffs, Lincoln, and Des Moines.

On Page 25, the problem or need of the current shortage of scenic drives, overlooks, trails, interpretive points, and parks along the Missouri River is discussed. It goes on to say that the problem--varies with locations and river bank topography, but a shortage of access combined with the presence of agricultural areas, industrial developments and other competitive land uses along the shores of the Missouri have tended to limit both use and view-ability of the river. This in turn has made it difficult for Lewis and Clark Trail buffs, for example, to follow the river and make any kind of meaningful on-the-ground tie-in between themselves, as modern day "adventurers," and those explorers of an earlier day.

It was found and stated on Page 27 that the most pressing current needs are for (1) development of planned boat access points on and access to the Missouri River; and (2) improvement and development of the Missouri River oxbow lakes.

Later on Page 29, under opportunities for additional recreation development, it stated that--the most important and widely mentioned Type I potential (scenic, historic, and natural areas) is the promotion and development of recreation sites, roads, trails, signs, interpretive facilities, and other improvements in connection with the Lewis and Clark Trail.

Page 31 contained the more outstanding State park, recreation area and program plans and possibilities in Iowa (listed below). It stated--a total of 4,800 acres or about 40 percent of the land area in State parks and recreation areas is intensively developed. There is very little expansion room left within existing areas, so virtually all future needs must be met at new areas or within acquired expansion areas.

1. Possible State parks or recreation areas at the following proposed projects = 1,000-acre lake near Sioux City, Boyer River Project, Little Sioux Project, Nishnabota Project (all under study), and the four oxbow lake complexes (all authorized or under construction).

2. Continued development of the 15 authorized Corps of Engineers Missouri River access points in Iowa. (The Corps Recreation Aspects of the Lower Missouri proposes **the development** of 19 sites on or near the Missouri River. See Appendix D for listing.)

3. Complete development of the new Lake Anita State Park in Cass County.

4. Continuing acquisition of stream fishing accesses; acquisition of new and recreational development of existing fish and game areas; development of boat marinas in the natural lakes area of northwestern Iowa; acquisition and development of expansion lands at existing State parks.

In addition, the bottom of Page 32, in talking of State and local fishing and hunting areas, states that--there are good potentials both for acquiring additional hunting and fishing areas and for developing existing areas with recreation facilities. Less than one-half percent of the land acreage in these areas is now intensively developed. In addition to facilities for camping, picnicking, and water sports, there are excellent possibilities at many areas for adding nature study-oriented trails, signs, view points and exhibits, or visitor center-museums.

Finally, on Pages 34 and 35, in reference to the private sector, it is stated that--the opportunities for development and improvement of recreation areas and facilities on private land are good. Hunting and fishing can be greatly improved in both quality and quantity on privately owned lands. There are opportunities for developing summer home sites and other facilities on natural waterways and around natural and artificially created bodies of water. Good opportunities exist for providing a wide variety of the "service" type facilities that are expected to be needed. The private sector can also provide service type facilities frequently needed in connection with public developments. In addition, there are growing opportunities in some areas for the establishment of industrial parks and other industry-provided recreation areas, vacation farms or ranches, sandpit lake swimming beaches, scenically located lodges and resorts, restful cabin developments, and boat cruises on the Missouri River.

In addition to the private sector, other opportunities include one or both of the unchannelized reaches of the Missouri River that may have the necessary attributes to warrant classification as a National or State scenic river or State waterway. Finally, the Mormon Trail carries sufficient potential and historic value to be classified as a National scenic trail.

Speaking at the December 5, 1964 Missouri Basin Inter-Agency Committee Meeting in Sioux City, Iowa, Mr. Glen Powers, Planning Director, Iowa State Conservation Commission, presented a paper on Iowa's Long Range Recreation Plans. This was presented as Appendix D in the meetings minutes. Of importance is this statement, "The Missouri, on our western boundary, probably has the greatest potential for recreational development of any one area that we could mention. With flood control a reality, a stable river channel, navigation and other factors of progress, we suspect a major buildup of people along the Missouri."

In May 1968 the MBIAC produced a report entitled, Tentative Needs and Problems - Missouri River Basin, as part of the Comprehensive Framework Study. This report deals with the main stem of the Missouri River, including those lands lying within a quarter mile depth on each side. This report further emphasizes the existing use and potential of the Missouri River.

In talking of the entire main stem on page 3, this statement is made: "All of the Missouri has great historical and/or aesthetic value and most of the main stem offers good to excellent boating, water skiing, fishing, and sightseeing opportunities."

On page 11, it is pointed out that 33 percent of the recreation water needs in the subarea (which includes western Iowa, parts of eastern Nebraska, Minnesota, Missouri, and Kansas - known as subregion 6B in the MBIAC framework study) might be met by the Missouri main stem by 1980. If this thought could be followed for any individual State, then 33 percent of western Iowa's water-oriented needs could be met by the main stem of the Missouri in 1980.

Recreation demand in 1980 on the main stem in the 6B subarea, which includes the Missouri in Iowa, is estimated at 10,520,000 activity-days. This does not include fishing and hunting. Sightseeing is the most popular activity accounting for about 40 percent of the estimated use.

In discussing specific problems and needs on page 14, this statement is made: "Water Pollution: Primarily a problem below Sioux City; limits recreation use and enjoyment of river."

In addition, on page 20, "Continued elimination of municipal and industrial pollution in the Missouri River, especially that from the Great Falls, Sioux City, Omaha, and Kansas City areas, so as to increase the attractiveness and usability of the river for all types of recreation."

OUTDOOR RECREATION IN IOWA

The Statewide comprehensive Outdoor Recreation Plan (SCORP) provides another basic source of information into the supply, demand and needs for outdoor recreation in western Iowa and along the Missouri River. It should be pointed out that Iowa's population is increasing, there are more visitors, there is more leisure time, more disposable income, and a highly intricate highway system which are indicative that the demand for recreation is on the upswing. Although demand is high for such activities as driving and walking for pleasure, sightseeing and bicycling, the need for facilities is apparently greatest for such activities as outdoor games and sports, swimming, picnicing, camping and boating. Multiple use recreation areas located adjacent to or around quality water bodies are highly desirable.

The tables below were derived from data supplied in the Iowa Recreation Survey of 1966 and depicts what the people of Iowa like to do as well as when. (Also on p. 118 and 121-123 in Outdoor Recreation in Iowa.)

Most Popular Outdoor Activities
(in % participating during entire yr.)

1.	Driving for pleasure	78.7%
2.	Picnicking	77.7%
3.	Sightseeing	58.8%
4.	Walking for pleasure	58.6%
5.	Attending outdoor sports events	48.3%
6.	Fishing	40.7%
7.	Games (outdoor)	38.2%
8.	Swimming	37.9%

9. Boating 35.0%

10. Bicycling 21.7%

Most Popular Summertime Activities
(June-August 1966)

1. Picnicking 75.8%
2. Driving 74.1%
3. Walking 54.9%
4. Sightseeing 53.7%
5. Attending outdoor sports events 38.7%
6. Fishing 37.8%
7. Swimming 36.9%
8. Playing outdoor games 36.8%
9. Boating 33.1%
10. Bicycling 19.0%

The State, for planning purposes, divided up the land area into geographical planning regions. Then based on supply and demand, and recreation standards, recreation acres needed were projected to 1985. The southwest and northwest regions generally overlap the area under review. Thus, the following table illustrates a latent demand for recreation. (Page 138 of the SCORP)

Gross-Area Recreation Needs by Region

Category	Existing Supply		Minimum Needed (1985)		Deficiency (1985)
	Acres	Ac./1000	Acres	Ac./1000	Acres
REGION IV - SOUTHWEST					
Municipal				15.0	
County	770	2.8	5,361	20.0	4,591
State	13,063	47.8	21,445	80.0	8,382
Federal	3,749	13.7	26,806	100.0	23,057
REGION V - NORTHWEST					
Municipal				15.0	
County	2,612	7.3	7,928	20.0	5,316
State	32,774	92.2	31,712	80.0	none
Federal	none	none	39,640	100.0	39,640

198

As can be seen, a deficiency of approximately 81,000 acres will be apparent in 1985 in the two planning regions which coincide with the area under review.

The proposed land acquisition as expressed in the capital improvement program (Appendix A of the report) for these two planning regions show that 28,280 acres will be acquired between 1968-1985 by the Iowa State Conservation Commission. While this does not include municipal, county, or Federal proposed acquisitions, an outstanding deficiency of almost 58,000 acres would remain.

The total public inventory of existing recreation resources within the area under review can be found in the Bureau of Outdoor Recreation's MBIAC report. As noted in these tables, total recreation visitation figures are not available for the area under review. The only figures tabulated involve use at 18 State parks and recreation areas. The total use amounted to 2,074,000 visitations.

The private sector inventory of recreation enterprises in the area of review, as taken from the Iowa plan, is contained in Appendix B.

Appendix C shows the participation of Iowans, 12 years and older, in away-from-home activities for the years 1965 to 1985. The basic data for these projections were also taken from the Iowa plan and relate specifically to planning Sections 4 and 5 (northwest and southwest portions of Iowa). A relative percentage of Iowa's total population was used in comparison with the population of Sections 4 and 5. The number of participants was then reduced by this percentage and total days computed. Total days of use in 1965 were 52,371,000, while in 1985 it increased to 54,132,000. Note the increase of nearly 2 million total days of participation in these two regions by 1985 and in particular note the significant rise in the water-related activities.

In addition, it is important to note that the percent participating as well as the mean days per participant were not increased for the 1985 projections. Due to more leisure time, and the ever-expanding population, these factors would increase the overall total quite drastically. Similarily, studies now show that a greater percentage of persons under 12 years of age participate in outdoor activities more frequently than previously thought. Also, these projections of use do not consider non-resident use which could be as much as the resident use. (See Page 12 of the MBIAC Report.)

Finally, the Lewis and Clark Trail development in western Iowa is sure to expand the role now played by out-of-state tourists. By 1985, the number of out-of-state recreationists visiting the various sites and locations along the Missouri River will add immeasurably to the percent participating as well as the total number participating. All of the above factors clearly spell out a rising demand and need.

Perhaps, the best composite of existing and proposed, public and private recreational developments on or near the Missouri River comes from the Corps of Engineer's Report on the Recreation Aspects of the Lower Missouri River. This listing is found in Appendix D.

It should be pointed out that the visitation projections accumulated by the Corps with respect to their proposed developments indicates the following recreational use. Based on available data, the Corps estimates that some 250,000 visitor-days presently occur between Rulo, Nebraska and Sioux City (the Iowa stretch of the Missouri River is situated within this area). After Corps development use is expected to increase to 500,000 visitor-days annually. After 50 years the annual visitation will reach 1 million.

In defining the roles and responsibilities of the various agencies having an interest in recreation, the State plan outlines the following purpose for the Iowa Water Pollution Control Commission.

The Water Pollution Control Commission was established in 1965 by the 61st General Assembly in an attempt "to conserve the waters of the State and to protect, maintain, and improve the quality thereof for public water supplies, for the propagation of wildlife, fish, and aquatic life, and for domestic, agricultural, industrial, recreational, and other legitimate (beneficial) uses; to provide that no waste be discharged into any waters of the State without first being given the degree of treatment necessary to protect the legitimate (beneficial) uses of such waters; to provide for the prevention, abatement and control of new, increasing, potential, or existing water pollution; and to cooperate with other agencies of the State, agencies of other States and the Federal Government in carrying out these objectives.

In addition to an earlier section on the Lewis and Clark Trail, the following is found on p. 195 of the "Outdoor Recreation in Iowa" report. The concept of the Lewis and Clark Trail system is to preserve and/or develop the scenic, historic, recreational, and cultural significance of the route and adjacent areas. The program below was recommended for the Iowa portion:

a. Designate a Lewis and Clark Trail Highway connecting with comparably designated highways in Missouri, Nebraska, and South Dakota. This route has been established as part of the scenic roads system in Iowa.

b. Develop a uniform system of information and directional signs and markers along this highway.

c. Acquire and develop additional public recreation areas, including a system of hiking and horseback trails.

d. Take corrective action to eliminate pollution in the Missouri River.

e. Assist and cooperate with private recreation enterprise interested in providing food, lodging, and other facilities associated with recreation and travel use.

f. Enhance the scenic nature of the Lewis and Clark Highway by the use of scenic easements.

g. Develop an extensive State campaign to promote the Trail.

The State Conservation Commission is assuming a leading role in encouraging development of the Iowa portion of the Lewis and Clark Trail. The plans call for a long range program of preservation and development of the area affected, and immediate efforts should be directed toward instituting initial phases of the proposal.

Finally on page 196 - Some interest has recently been indicated in marking and developing the Mormon Trail route across southern Iowa used by the Mormons in their march to the Salt Lake region of Utah. The Conservation Commission has begun preliminary investigation of this route and should expand its efforts to include other interested agencies and organizations in marking the route and encouraging and directing the preservation and development of significant sites and areas adjacent to the Mormon Trail.

THE MIDDLE MISSOURI

The Bureau of Outdoor Recreation's study report entitled, The Middle Missouri proposes many actions for a 1,265-mile stretch of the Missouri River upstream from Iowa. It is worth mentioning that one of the recommendations is that "the States should enforce high standards of water quality." The actions required include:

1. Early State action to reduce pollution threat.
2. Implementation and enforcement of 1965 Water Quality Act (PL-89-234).
3. Expand education and control programs.

From this brief statement, it can be seen that Iowa's upstream neighbors will be called upon to provide its downstream users with the good water quality--the same as Iowa's downstream users have the right to expect.

It is understood that Governor Hughes requested the Lewis and Clark Trail Commission to promote a similar "Lower Missouri" study by the BOR. At their June 28, 1968, Meeting the L&CC resolved to petition the Senators of Missouri, Kansas, Nebraska, and Iowa to use their offices to secure a study by the Department of the Interior.

CONCLUSION

In the foregoing summaries an attempt has been made to show the relative significance of recreational benefits in a water-oriented environment. The key role of state governments, the tremendous recreational potential of the Lewis and Clark Trail, the detrimental effects of any and all levels of water pollution, the surge and importance of water related recreation activities--all of these tell a story and it is one of an overwhelming need.

As seen in the preceding pages a general concensus exists concerning the development and potential of outdoor recreation in western Iowa. The concensus is two-fold. It is simply that (1) a huge latent demand for water-oriented outdoor recreation opportunities and facilities exists and that (2) full satisfaction of this demand can manifest itself only if a massive and intensified effort be made to capitalize on the existing available opportunities. This concensus is shared by both the Federal and State establishments.

Inherent is the fact that secondary treatment along the main stem of the Missouri River will ameliorate the river's present condition. As we have seen, the future benefits to be gained are numerous.

In addition to the recreation activities in western Iowa, the downstream reaches of the Missouri River adjacent to Kansas and down into Missouri may well experience desirable effects. By enhancing water quality in the upper portions of the Missouri River, the recreational needs of those downstream will be better served.

Of tantamount importance is the value of intangible benefits to be had through improving the land and water resources. These benefits cannot be measured in numbers--they can only be measured in words. All the splendor and beauty of a natural setting has overwhelming value to many rural and city dwellers alike. The quality of the experience is a direct reflection on the quality of the environment. To improve the environment is to elevate the quality of the recreational experience many times over. The experience is, for thousands of Americans, a sort of self-realization and at its most basic level--a certain oneness with nature. The uniqueness, the natural beauty, the quality and aesthetic values that could be preserved and improved along the Missouri are indeed worth the effort.

Similarly, the forces acting on the recreation demand cannot be understated. Take the expanding mobility of today's vacationists and travelers, the rising amounts of money available for fun as well as the ever increasing time for leisure. Then add to these a mushrooming population and the overall situation suddenly becomes urgent.

In conclusion, the recreational demands have been identified and the supply has been found deficient. The resulting needs dictate that further enhancement of the quality of the Missouri River is highly desirable.

Yes, the outdoor recreation demands have become imperative--and so also have the needs. It would be inimical to the development of effective pollution abatement goals and water quality enhancement measures if the only course of action to be taken is no action at all.

Enhancement of the Missouri River is necessary. It will ultimately improve water quality, it will yield more tangible as well as intangible benefits, it will provide the groundworks for satisfying quality recreational needs, and it will do so for generations to come.

And in the last analysis, who will benefit the most? It is sure to be the people of this land--the Kansans, the Nebraskans, the Missourians--and most of all, the Iowans themselves.

APPENDIX A

SCHEDULING OF CAPITAL IMPROVEMENT ITEMS
STATE CONSERVATION COMMISSION

Area	Land Acquisition	Lands and Waters		Fish and Game		Total
		Initial*	Future**	Initial*	Future**	
REGION IV--SOUTHWEST						
Missouri River		$ 34,567.16				$ 34,567.16
Green Valley S.R.A.	549.92 ac	240,465.58				240,465.58
Lake Anita S.R.A.		177,739.99				177,739.99
Lake of Three Fires S.R.A.		136,204.33				136,204.33
Nine Eagles S.R.A.		122,602.81				122,602.81
Prairie Rose S.R.A.		42,408.20				42,408.20
Viking Lake S.R.A.		10,848.00				10,848.00
Waubonsie S.P.	374 ac	153,274.92				153,274.92
Lake Manawa S.R.A.		10,000.00				10,000.00
Walters Creek Watershed	1,810 ac	89,315.00		$ 89,315.00		788,960.00
3-Mile Creek Watershed	2,045 ac	169,306.00		169,306.00		996,734.00
Stream Fishing Accesses	60 ac			12,000.00		12,000.00
Waterfowl Area Dev.	17,000 ac			200,000.00	3,200,000.00	3,400,000.00
Fish & Game Areas	155 ac			52,000.00		52,000.00
Adair Wildlife Area	350 ac			48,750.00		48,750.00
Recreation Lake Dev.	350 ac	50,000.00	$ 150,000.00			200,000.00
TOTALS	22,693.92 ac	$1,236,731.00	$ 150,000.00	$571,371.00	$3,200,000.00	$6,426,554.00

*Initial period for capital improvements funding extends from 1968 to 1973.
**Future period for capital improvements funding extends from 1973 to 1985.

1. Cost-sharing by cooperating agencies: $610,330.00
2. Cost-sharing by cooperating agencies: $658,122.00

SCHEDULING OF CAPITAL IMPROVEMENT ITEMS
STATE CONSERVATION COMMISSION (Con't)

Area	Land Acquisition	Lands and Waters		Fish and Game		Total
		Initial*	Future**	Initial*	Future**	
REGION V--NORTHWEST						
Black Hawk Lake S.R.A.	1,998 ac.	$ 350,518.80	$ 231,750.00	$133,250.00	$ 303,500.00	$1,019,018.8
Gitchie Manitou S.P.		2,800.00				2,800.0
Gull Point S.R.A.		6,415.32				6,415.3
Mill Creek S.R.A.		2,300.00				2,300.0
Pikes Point S.R.A.		4,716.00				4,716.0
Swan Lake Park	262 ac.	28,394.30				28,394.3
Iowa Lake		5,000.00				5,000.0
Spirit Lake		85,000.00				85,000.0
Western Iowa Loess Area	500 ac.	75,000.00				75,000.0
Lewis & Clark S.R.A.		23,000.00				23,000.0
Stone S.P.		2,000.00				2,000.0
Trappers Bay S.R.A.		2,000.00				2,000.0
Storm Lake		165,000.00				165,000.0
Browns Lake S.R.A.				1,500.00		1,500.0
Spirit Lake Fish Hatchery				3,500.00		3,500.0
East Okoboji Lake				1,500.00		1,500.0
Arnolds Park Station				3,000.00		3,000.0
Stream Fishing Accesses	70 ac.			14,000.00		14,000.0
Fish & Game Areas	760 ac.			182,200.00		182,200.0
Big Sioux Wildlife Area	1,000 ac.			130,000.00		130,000.0
Elliott Cr. & Whiskey Cr.	1,000 ac.			800,000.00		800,000.0
TOTALS	5,590 ac.	$ 752,144.42	$ 231,750.00	$1,268,950.00	$ 303,500.00	$2,556,344.4

*Initial period for capital improvements funding extends from 1968 to 1973.
**Future period for capital improvements funding extends from 1973 to 1985.

From: Outdoor Recreation in Iowa, pp. 283-305

Appendix B

PRIVATE SECTOR RECREATION ENTERPRISES
(on or near Mo. River)

Iowa

County		Enterprise	Location
Fremont	1.	Knox Basin	Hamburg
	2.	Webb Foot Haven	Bartlett
	3.	Stanley Boat Landing	Thurman
	4.	Hamburg Boat Landing	Hamburg
	5.	American Legion	Sidney
	6.	Shull Farm	Riverton
Harrison	1.	Missouri Valley Boy Scouts	Missouri Valley
	2.	Boy of Craft	"
	3.	Western Iowa Fish and Wildlife Club	"
	4.	Honk and Quack Lodge	"
	5.	Logan-Missouri Valley Country Club	"
	6.	Modale Boy Scouts	Modale
	7.	Horseshoe Lake	"
	8.	Linn Lake	Mondamin
Lyon		(none)	
Mills		(none)	
Monona	1.	Willaday Farm	Whiting
	2.	Onawa Country Club	Onawa
	3.	Ruth's Marina	Whiting
	4.	Whiting Gun Club	"
	5.	Monona County Rural Electric Co-op Roadside Park	Onawa

	6.	Christian Church Camp, First Christian Church	Onawa
Plymouth		(none)	
Pottawattamie	1.	Hidden Valley Shooting Preserve	Honey Creek
	2.	Crescent Ski Hills	"
	3.	K. G. Ranch	Council Bluffs
	4.	Toman's Goose Haven	"
	5.	Rainbow Ranch	"
	6.	Council Bluffs Archery Range	"
	7.	Elks Country Club	Lake Manawa
	8.	Fish and Game Protective Association Lake Manawa	Council Bluffs
	9.	Campbell's Boat Livery	Lake Manawa
	10.	Council Bluffs Boat Club	Council Bluffs
	11.	Hi-Y Camp	"
	12.	Chalet Club	"
	13.	Camp Waconda (Boy Scouts)	"
	14.	Rocking Chair Ranch	"
	15.	Twin City Plaza Swimming Pool	"
	16.	Dolphin Swim Club	"
	17.	Cabana Swimming Club	"
	18.	Town and Country Aqua Club	"
Sioux	1.	Hawarden Country Club	Hawarden (Big Sioux River)
Woodbury	1.	Snyder Bend Park	Salix
	2.	Izaak Walton League	Sioux City
	3.	Lake View Resort	Salix

209-B

4.	Sgt. Floyd Monument - Sportland	Sioux City
5.	Target Range	Sgt. Bluffs
6.	Sioux City Gun Club	Sioux City
7.	Hawkeye Gun Club	"
8.	South Sioux Marina	"
9.	Button Willows	"

APPENDIX C

PARTICIPATION OF IOWANS 12 YEARS & OLDER IN AWAY-FROM-HOME ACTIVITIES (SEPTEMBER 1965 - SEPTEMBER 1966) FOR REGIONS 4 & 5

Activity	% Part.	No. Part.	Mean Days Per Part.	Total Days
Bicycling	21.7	120,365	27.9	3,358,183
Horseback riding	11.9	66,006	9.6	633,657
Playing outdoor games	38.2	211,887	15.7	3,326,625
Golf, regular	9.4	52,139	19.8	1,032,352
Golf, miniature	10.0	55,467	4.5	249,601
Tennis	6.5	36,054	7.0	252,378
Badminton	9.6	53,249	5.7	303,519
Basketball	8.2	45,483	9.6	436,636
Baseball, softball	21.7	120,365	12.4	1,492,526
Archery	3.6	19,968	4.1	81,868
Horseshoes, croquet	7.9	43,819	6.1	267,295
Football, etc.	11.6	64,342	7.8	501,867
Fishing	40.7	225,754	10.4	2,347,841
Trout	2.0	11,093	3.9	43,262
Other	40.4	224,090	10.2	2,285,718
Canoeing	4.6	25,515	4.6	117,369
Sailing	1.6	8,874	2.1	18,635
Other boating	35.0	194,137	6.7	1,300,717
Swimming	37.9	210,223	13.3	2,795,965
Ocean	3.0	16,640	3.8	63,232
Lake	24.5	135,896	6.5	883,324
Stream	5.4	29,952	4.1	122,803
Pool	22.4	124,247	13.9	1,727,033
Water skiing	5.9	32,726	5.2	170,175
Hunting	18.5	102,615	8.7	892,750
Small game	17.2	95,404	7.0	667,828
Big game	0.7	3,882	4.7	18,240
Waterfowl	0.9	4,992	7.3	364,416
Camping	15.1	83,756	7.3	611,418
Developed (trailer)	6.6	36,608	9.2	336,793
Developed (tent)	7.4	41,046	5.4	221,648
Wilderness	2.2	12,202	3.2	39,046
Mountain-rock climbing	0.7	3,882	3.3	12,810
Hiking	3.2	17,749	4.2	74,545
Walking for pleasure	58.6	325,041	15.3	4,973,127
Bird watching	9.8	54,358	7.3	396,813
Wildlife photography	3.3	18,304	4.0	73,216
Nature walks	15.3	84,865	5.5	466,757
Picnics	77.7	430,985	7.4	3,189,289
Driving for pleasure	78.7	436,531	17.8	7,770,251
Sightseeing	58.8	326,151	7.5	2,446,132
Attend outdoor sports	48.3	267,909	9.0	2,411,181

Activity	% Part.	No. Part.	Mean Days Per Part.	Total Days
Attend outdoor plays	18.7	103,725	4.2	435,645
Target-trap shooting	6.2	34,390	7.5	257,925
Motorcycling	9.0	49,920	19.2	958,464
Gardening	9.5	52,694	12.2	642,866
Ice skating	8.4	46,593	5.0	232,965
Snow skiing	1.6	8,874	3.9	34,608
Sledding	16.5	91,494	5.4	494,067
County fair	10.7	59,350	2.3	136,505
Sunbathing-relaxing	5.0	27,733	2.9	80,425
Trampoline	0.4	2,218	5.3	11,755
Hayrides, etc.	0.7	3,882	3.5	13,587
Marching band, etc.	2.0	11,093	13.3	147,536
Kite flying, etc.	2.3	12,757	3.5	44,649
Mushroom-berry picking	3.1	17,194	5.9	101,444
			GRAND TOTAL	52,371,000

PARTICIPATION OF IOWANS 12 YEARS & OLDER IN AWAY-FROM-HOME ACTIVITIES (12-MONTH PERIOD 1985) FOR REGIONS 4 & 5

Activity	% Part.	No. Part.	Mean Days Per Part.	Total Days
Bicycling	21.7	128,200	27.9	3,576,780
Horseback riding	11.9	70,303	9.6	674,908
Playing outdoor games	38.2	225,088	15.7	3,533,881
Golf, regular	9.4	55,533	19.8	1,099,553
Golf, miniature	10.0	59,078	4.5	265,851
Tennis	6.5	38,400	7.0	268,800
Badminton	9.6	56,715	5.7	323,275
Basketball	8.2	48,444	9.6	465,062
Baseball, softball	21.7	128,200	12.4	1,589,680
Archery	3.6	21,268	4.1	87,198
Horseshoes, croquet	7.9	46,671	6.1	284,693
Football, etc.	11.6	69,121	7.8	539,143
Fishing	40.7	240,449	10.4	2,500,669
Trout	2.0	11,815	3.9	46,078
Other	40.4	238,676	10.2	2,434,495
Canoeing	4.6	27,176	4.6	125,009
Sailing	1.6	9,452	2.1	19,849
Other boating	35.0	206,774	6.7	1,385,385
Swimming	37.9	223,907	13.3	2,977,963
Ocean	3.0	17,723	3.8	67,347
Lake	24.5	144,742	6.5	940,823
Stream	5.4	31,902	4.1	130,798
Pool	22.4	132,335	13.9	1,839,456
Water skiing	5.9	34,856	5.2	181,251
Hunting	18.5	109,295	8.7	950,866
Small game	17.2	101,614	7.0	711,298
Big game	0.7	4,135	4.7	194,345
Waterfowl	0.9	5,317	7.3	38,814
Camping	15.1	89,208	7.3	651,218
Developed (trailer)	6.6	38,991	9.2	358,717
Developed (tent)	7.4	43,717	5.4	236,071
Wilderness	2.2	12,997	3.2	41,590
Mountain-rock climbing	0.7	4,135	3.3	13,645
Hiking	3.2	18,905	4.2	79,401
Walking for pleasure	58.6	346,199	15.3	5,296,844
Bird watching	9.8	57,896	7.3	422,640
Wildlife photography	3.3	19,495	4.0	77,980
Nature walks	15.3	90,389	5.5	497,139
Picnics	77.7	259,039	7.4	1,916,888
Driving for pleasure	78.7	464,947	17.8	8,276,056
Sightseeing	58.8	347,381	7.5	2,605,357
Attend outdoor sports	48.3	285,348	9.0	2,568,132
Attend outdoor plays	18.7	110,476	4.2	463,999
Target trap shooting	6.2	36,628	7.5	274,710
Motorcycling	9.0	53,170	19.2	1,020,864

Activity	% Part.	No. Part.	Mean Days Per Part.	Total Days
Gardening	9.5	56,124	12.2	684,712
Ice skating	8.4	49,625	5.0	248,125
Snow skiing	1.6	9,452	3.9	36,862
Sledding	16.5	97,479	5.4	526,386
County fair	10.7	63,213	2.3	145,389
Sunbathing-relaxing	5.0	29,539	2.9	85,663
Trampoline	0.4	2,363	5.3	12,523
Hayrides, etc.	0.7	4,135	3.5	14,472
Marching band, etc.	2.0	11,815	13.3	157,139
Kite flying, etc.	2.3	13,588	3.5	47,558
Mushroom-berry picking	3.1	18,314	5.9	108,052
			GRAND TOTAL	54,132,000

APPENDIX D

IOWA - LEWIS AND CLARK
HISTORIC, WILDLIFE AND RECREATION AREAS
(on or near Missouri River)

Existing (private and public)

1. Hamburg Boat and Gun Club - Ramp
2. Auldon Bar Island - State Recreation Area
3. Shenandoah Boat Club - Dock
4. Nottleman Island - State Recreation Area
5. Tri-County Boat Dock
6. Lake Manawa State Park
7. Twin City Boat Marina
8. Council Bluffs Boat Club - Dock
9. Council Bluffs Historic Sites
10. Wilson Island State Park
11. DeSoto Bend National Wildlife Refuge
12. H. A. Peterson Boat Marina
13. E. Peterson Boat Marina
14. Onawa Access Recreation Area
15. Don Ruth Marina
16. Monona County Recreation Area
17. Sergeant Floyd Monument
18. Sioux City Historic Sites
19. Gifford Wildlife Sanctuary - State
20. Smith State Wildlife Refuge

Proposed (private and public)

1. State Line Island - State Recreation Area
2. Otoe Bend Island - State Recreation Area

3. Copeland Bend Island - State Recreation Area
4. Percival Area (Corps of Engineers)
5. Glenwood Area (Corps of Engineers)
6. Gifford Area (Corps of Engineers)
7. Narrows Area (Corps of Engineers)
8. Sand Bar - State Recreation Area
9. Wilson Island (State and Corps of Engineers River Access)
10. California Bend - State Recreation Area
11. Oxbow Lakes (Corps of Engineers and State)
12. Tyson Bend - State Recreation Area
13. Sandy Point Area (Corps of Engineers)
14. River Stone Area (Corps of Engineers)
15. River Stone State Recreation Area
16. Pickle City Area (Corps of Engineers)
17. Blackbird Area (Corps of Engineers)
18. Oxbow Lakes (Corps of Engineers and State)
19. Rabbit Island - State Recreation Area
20. Omaha Mission Bend Area (Corps of Engineers)
21. Oxbow Lake (Corps of Engineers and State)
22. Snyder Bend Area (Corps of Engineers)
23. Dakota Bend State Wildlife Refuge
24. Floyd Bend Area (Corps of Engineers)
25. Marina (Sioux City and Corps of Engineers)
26. Hamburg Landing (Corps of Engineers)
27. Bartlett Landing (Corps of Engineers)
28. Dodge Park (Corps of Engineers and City of Council Bluffs)

APPENDIX D

WATER QUALITY MONITORING STATIONS
ON INTERSTATE STREAMS
IOWA
1969

WATER QUALITY MONITORING STATIONS
ON INTERSTATE STREAMS
IOWA
1969

Stream & Station	Temperature	pH	Turbidity	Dissolved Oxygen	BOD5	COD	Chloride	Sulfate	Phosphate	Alkalinity	Hardness	TDS	Detergent (MBAS)	Spec. Cond.	Total Coliform	Fecal Coliform	Biological1/	Radiological2/	Organics3/	Group "A"(Metals)	Group "B"5/	Group "C"6/	Phenols	Nitrogen Forms	Agency	Remarks
Big Sioux River																										
Above Sioux City, Iowa	Q	Q	Q	Q	Q	Q			Q	Q	Q	Q			Q			M		SA8/	Q	Q	SA	Q	IWPCC	
Above Hawarden, Iowa	-	-	-	-	-	-			-			-						-		-8/	-		-	-	IWPCC	Proposed
Below Hawarden, Iowa	-	-	-	-	-	-			-			-						-		-8/	-		-	-	IWPCC	Proposed
Rock River																										
Above Rock Rapids, Iowa	-	-	-	-	-	-			-			-						-		-8/	-		-	-	IWPCC	Proposed
Below Rock Rapids, Iowa	-	-	-	-	-	-			-			-						-		-8/	-		-	-	IWPCC	Proposed
Near Lebanon, Iowa	Q	Q	Q	Q	Q	Q			Q	Q	Q	Q			Q						Q	Q		Q	IWPCC	
Little Sioux River																										
Near Onawa, Iowa	Q	Q	Q	Q	Q	Q			Q	Q	Q	Q			Q					SA8/	Q	Q	SA	Q	IWPCC	
Above Cherokee, Iowa	-	-	-	-	-	-			-			-						-		-8/	-		-	-	IWPCC	Proposed
Below Cherokee, Iowa	-	-	-	-	-	-			-			-						-		-8/	-		-	-	IWPCC	Proposed
Above Spencer, Iowa	Q	Q	Q	Q	Q	Q			Q	Q	Q	Q			Q						Q	Q		Q	IWPCC	
Below Spencer, Iowa	-	-	-	-	-	-			-			-						-		-8/	-		-	-	IWPCC	Proposed
Nishnabotna River																										
Above Hamburg, Iowa	Q	Q	Q	Q	Q	Q			Q	Q	Q	Q			Q						Q	Q		Q	IWPCC	
Below Hamburg, Iowa	-	-	-	-	-	-			-			-						-		-8/	-		-	-	IWPCC	Proposed
Nodaway River																										
Above Clarinda, Iowa	Q	Q	Q	Q	Q	Q			Q	Q	Q	Q			Q						Q	Q			IWPCC	
Below Clarinda, Iowa	-	-	-	-	-	-			-			-						-		-8/	-		-	-	IWPCC	Proposed
102 River																										
Above Bedford, Iowa	Q	Q	Q	Q	Q	Q			Q	Q	Q	Q			Q						Q	Q			IWPCC	
Below Bedford, Iowa	-	-	-	-	-	-			-			-						-		-8/	-		-	-	IWPCC	Proposed
Chariton River																										
Above Centerville, Iowa	Q	Q	Q	Q	Q	Q			Q	Q	Q	Q			Q					SA8/	Q	Q	SA	Q	IWPCC	
Below Centerville, Iowa	-	-	-	-	-	-			-			-			-			-		-8/	-		-	-	IWPCC	Proposed
Below Chariton, Iowa	Q	Q	Q	Q	Q	Q			Q	Q	Q	Q			Q						Q	Q		Q	IWPCC	
Missouri River																										
At Nebraska City, Nebr.	C	M					M	M			M	M		C				M	M	M	M	M		M	USGS	
Below Bellevue, Nebr.	W	W	W	W	W		W	W	W	W	W	W	W	W	W	U	S	M	M	W	W		M	W	FWPCA	Proposed
At Council Bluffs, Iowa	Q	Q	Q	Q	Q	Q			Q	Q	Q	Q			Q			M		SA8/	Q	Q	SA	Q	IWPCC	
Below Council Bluffs, Iowa	-	-	-	-	-	-			-			-			-			-		-8/	-		-	-	IWPCC	Proposed
At Omaha, Nebr.	W9/	W9/	W	W9/	W		W	W	W	W	W	W	M	W9/	W	W	S	W	M	W	W			W	FWPCA	
Near Decatur, Nebr.	W	W	W	W	W		W	W	W	W	W	W	W	W	W	W	S	W	M	W	W		M	W	FWPCA	Proposed
Above Sioux City, Iowa	Q	Q	Q	Q	Q	Q			Q	Q	Q	Q			Q			M		SA8/	Q	Q	SA	Q	IWPCC	
Below Sioux City, Iowa	-	-	-	-	-	-			-			-			-			-		-8/	-		-	-	IWPCC	Proposed
Boyer River																										
Missouri Valley, Iowa	Q	Q	Q	Q	Q	Q			Q	Q	Q	Q			Q						Q	Q		Q	IWPCC	Intrastate Stream
Floyd River																										
James, Iowa	Q	Q	Q	Q	Q	Q			Q	Q	Q	Q			Q						Q	Q		Q	IWPCC	Intrastate Stream

FOOTNOTES FOR APPENDIX D

1/ Biological includes:

Algae
Diatoms
Rotifers
Crustaceans

2/ Radiological includes:

Suspended gross alpha and beta activity
Dissolved gross alpha and beta activity
Total gross alpha and beta activity
Strontium - 90

3/ Organics include:

Aldrin
Dieldrin
Endrin
Heptachlor
Heptachlor Epoxide
DDT
DDE
DDD

4/ Group "A" includes:

Arsenic
Barium
Strontium
Beryllium
Cadmium
Chromium
Cobalt
Copper
Lead
Molybdenum
Nickel
Phosphorus
Silver
Vanadium
Zinc
Total Organic Carbon

5/ Group "B" includes:

Color
Sodium
Potassium
Fluoride
Boron
Iron
Manganese

6/ Group "C" includes:

Silica
Calcium
Magnesium
Bicarbonate
Carbonate

8/ Includes only arsenic, barium, cadmium, chromium and lead.

9/ Also determined continuously by automatic monitor.

Sampling Frequency

- - Dash indicates sampling frequency has not been determined
C - Continuous monitor
D - Daily
W - Weekly
M - Monthly
S - Seasonal
B - Bi-monthly
K - Bi-weekly
Q - Quarterly
SA - Semi-annually

Agency

FWPCA - Federal Water Pollution Control Administration
USGS - U.S. Geological Survey
CE - Corps of Engineers
IWPCC - Iowa Water Pollution Control Commission

APPENDIX E

U. S. GEOLOGICAL SURVEY TEMPERATURE STATIONS
on
INTERSTATE STREAMS OF IOWA

APPENDIX E

U. S. GEOLOGICAL SURVEY TEMPERATURE STATIONS on INTERSTATE STREAMS OF IOWA

Stream and Station	Maximum Recorded Temperature °F
Rock River	
at Rock Rapids, Iowa	79
near Rock Valley, Iowa	92
Little Sioux River	
at Gillett Grove, Iowa	88
at Correctionville, Iowa	90
near Kennebec, Iowa	89
near Turin, Iowa	90
West Nishnabotna River*	
at Hancock, Iowa	82
at Randolph, Iowa	91
East Nishnabotna River*	
near Atlantic, Iowa	82
at Red Oak, Iowa	95
Nishnabotna River	
above Hamburg, Iowa	90
Tarkio River	
at Stanton, Iowa	91
Nodaway River	
at Clarinda, Iowa	94
East Fork of 102 River	
at Bedford, Iowa	88
Thompson River	
at Davis City, Iowa	88
Weldon River	
near Leon, Iowa	94
Chariton River	
near Chariton, Iowa	87
near Rathbun, Iowa	87

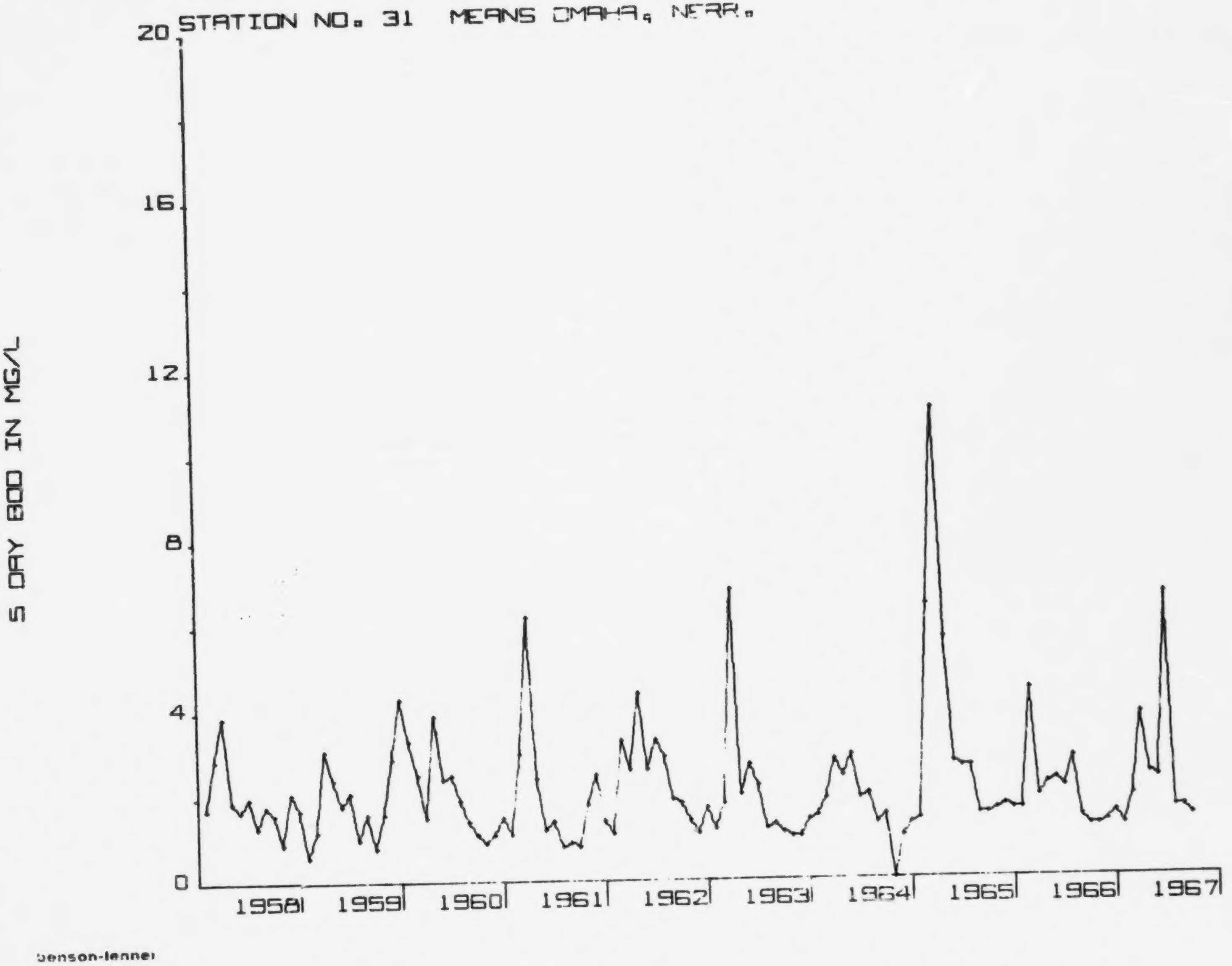
*Intrastate

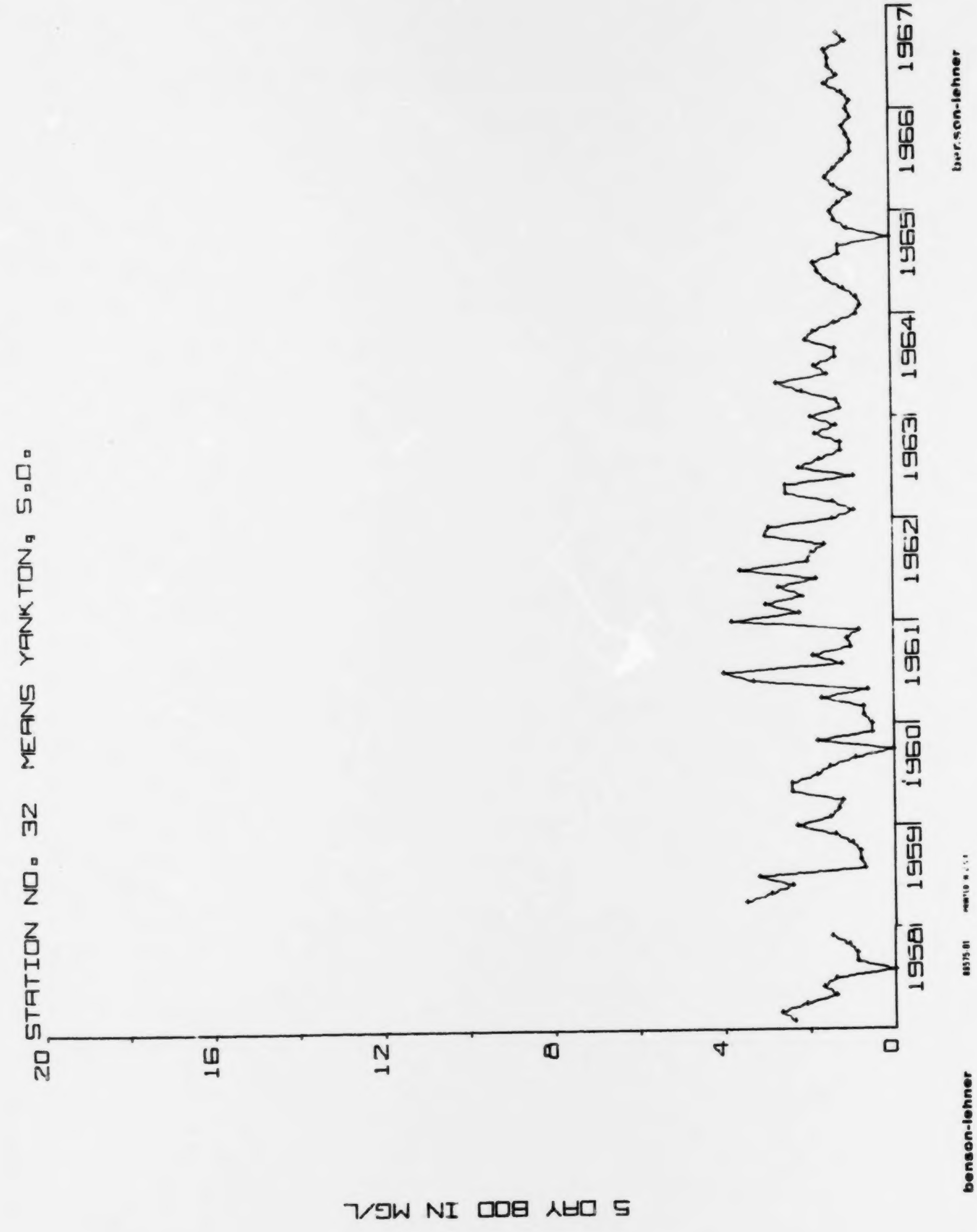
APPENDIX F

GRAPHS OF SURVEILLANCE DATA FROM ST. JOSEPH, MISSOURI, OMAHA, NEBRASKA, AND YANKTON, SOUTH DAKOTA

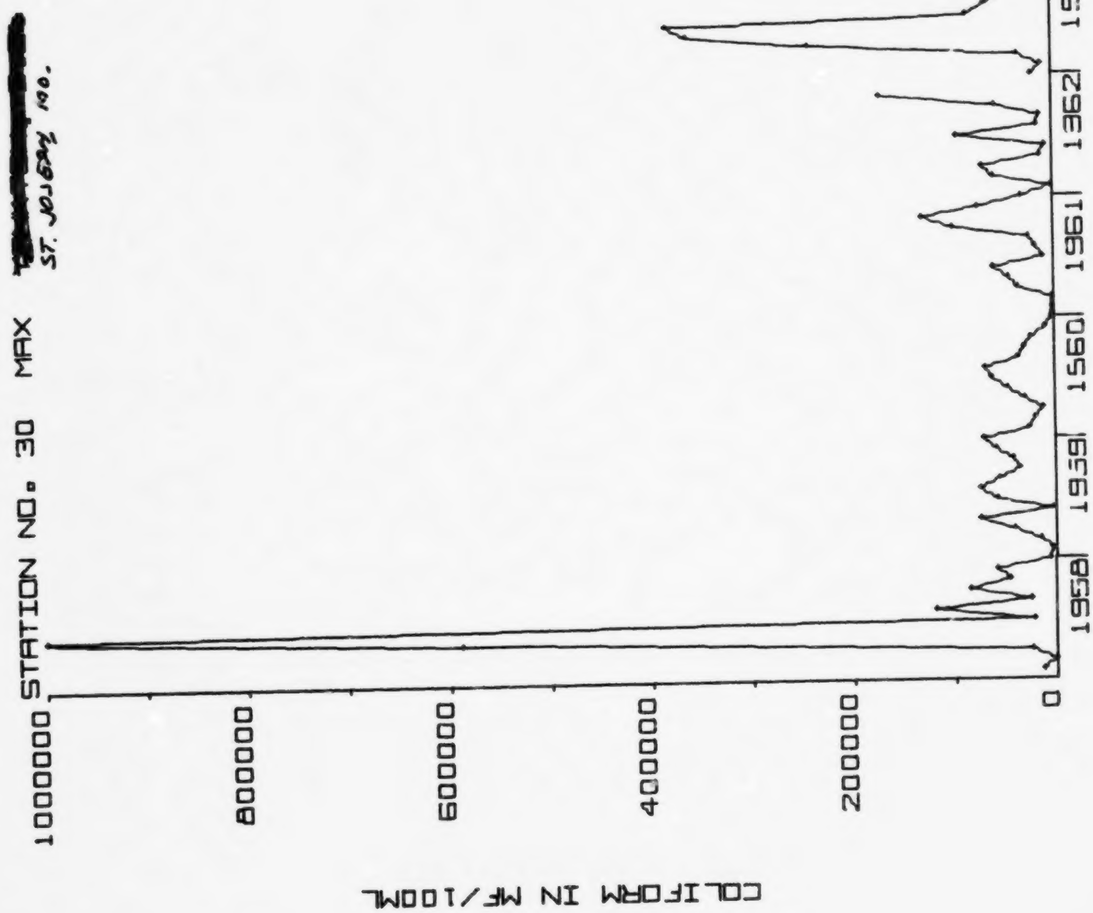
TEMPERATURE, MAXIMUM °C F-1
MEAN FLOW, CUBIC FEET PER SECOND F-2
DISSOLVED OXYGEN, 1
    MINIMUM, MG/L F-3
    MEAN, MG/L F-4
B.O.D.
    MAXIMUM, MG/L F-5
    MEAN, MG/L F-6
COLIFORM,
    MAXIMUM, MF/100 ML F-7
    MEAN, MF/100 ML F-8

NOTE: GRAPH WITH S,O,Y AFTER PAGE NUMBERS REFER TO ST. JOSEPH, OMAHA OR YANKTON DATA. STATIONS ARE ALSO NUMBERED 30-31-32 AS PART OF THE WATER QUALITY SURVEILLANCE NETWORK IDENTIFICATION.

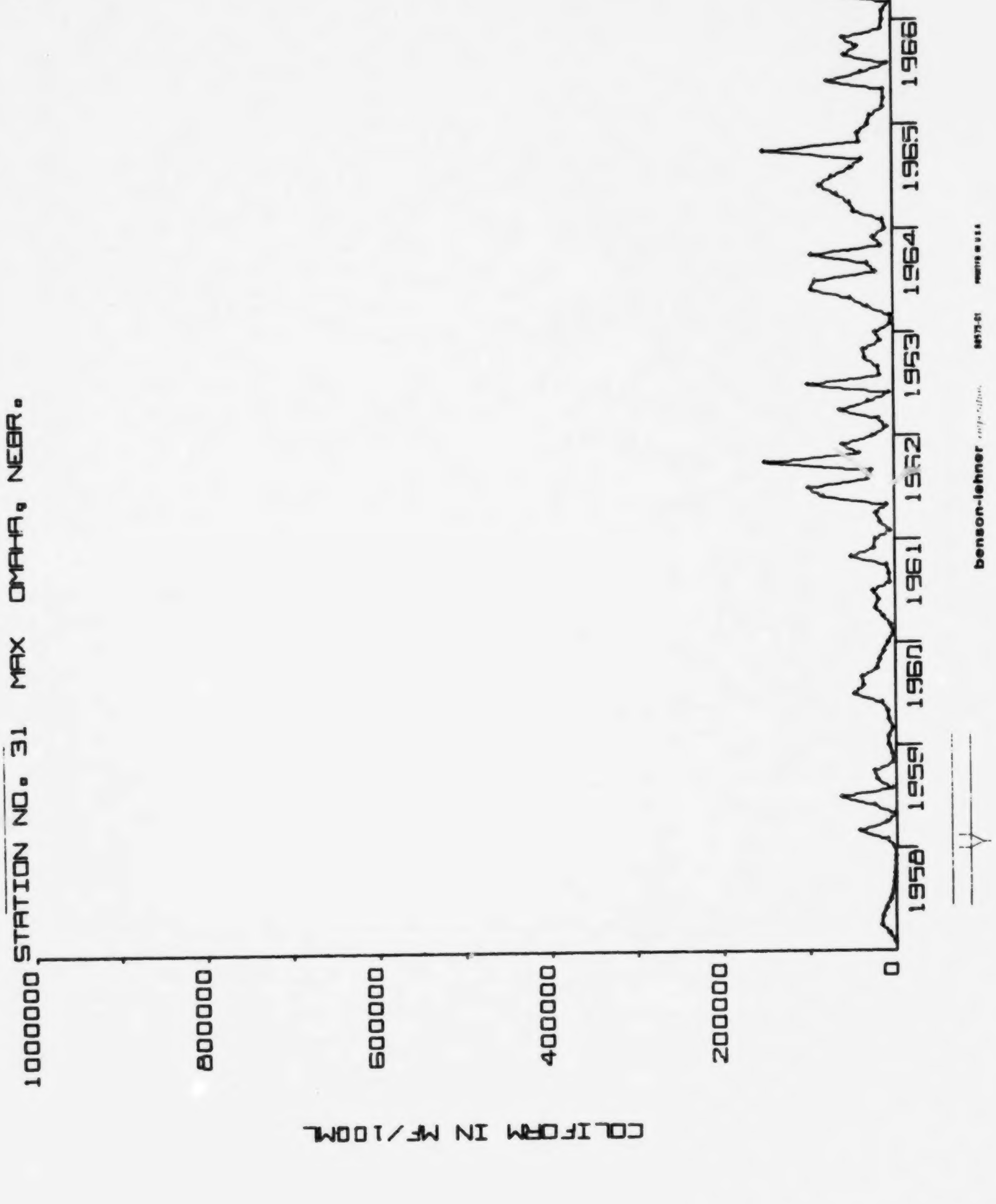

STATION NO. 31 MEANS OMAHA, NEBR.
5 DAY BOD IN MG/L
20
16
12
8
4
0
1958
1959
1960
1961
1962
1963
1964
1965
1966
1967
benson-lehner


STATION NO. 32 MEANS YANKTON, S.D.
5 DAY BOD IN MG/L
20
16
12
8
4
0
1958
1959
1960
1961
1962
1963
1964
1965
1966
1967
benson-lehner

F-7-5


STATION NO. 30 MAX
[redacted] ST. JOSEPH MO.
COLIFORM IN MF/100ML
1000000
800000
600000
400000
200000
0
1958
1959
1960
1961
1962
1963
1964
1965
1966
1967

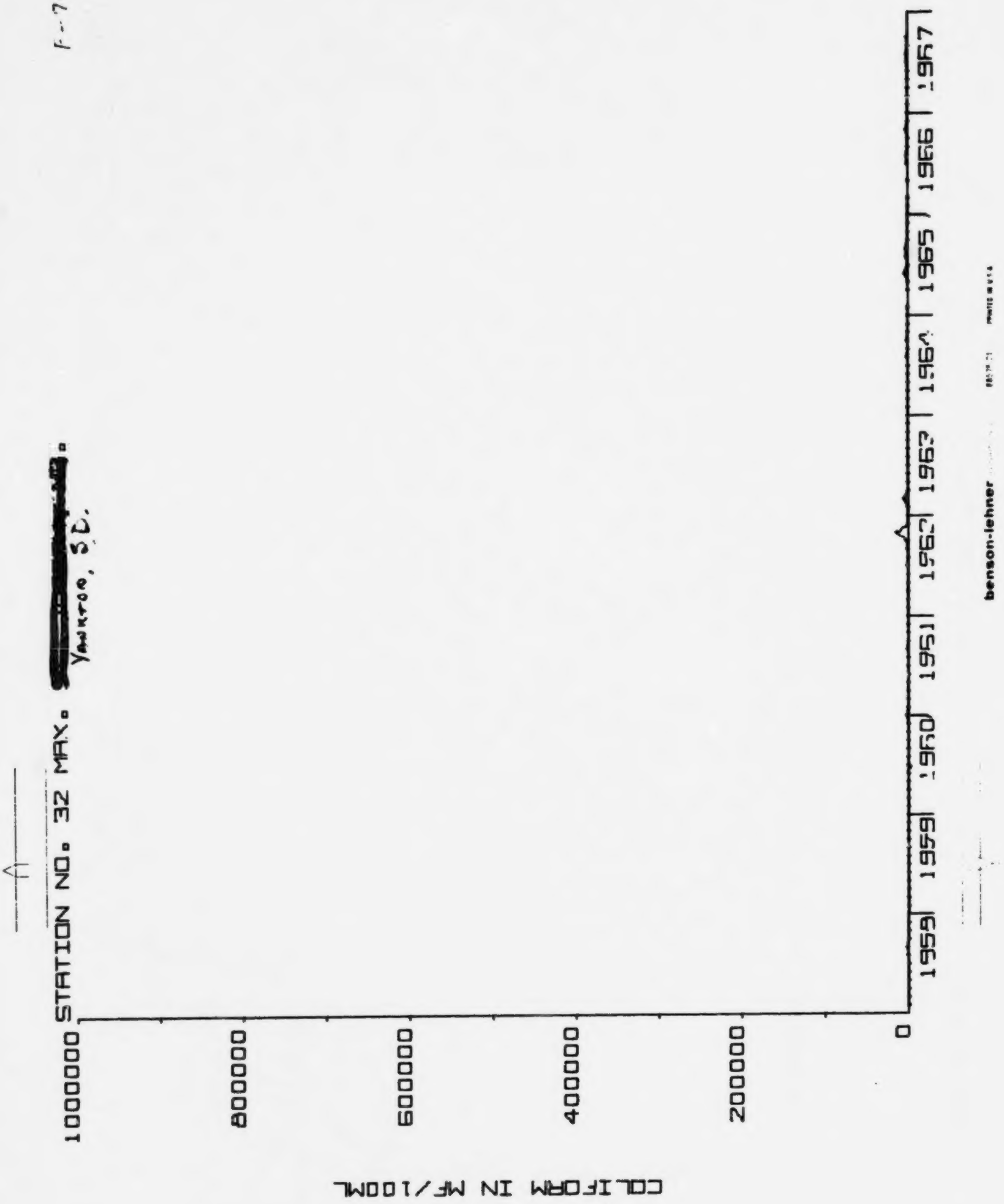
F-7-0

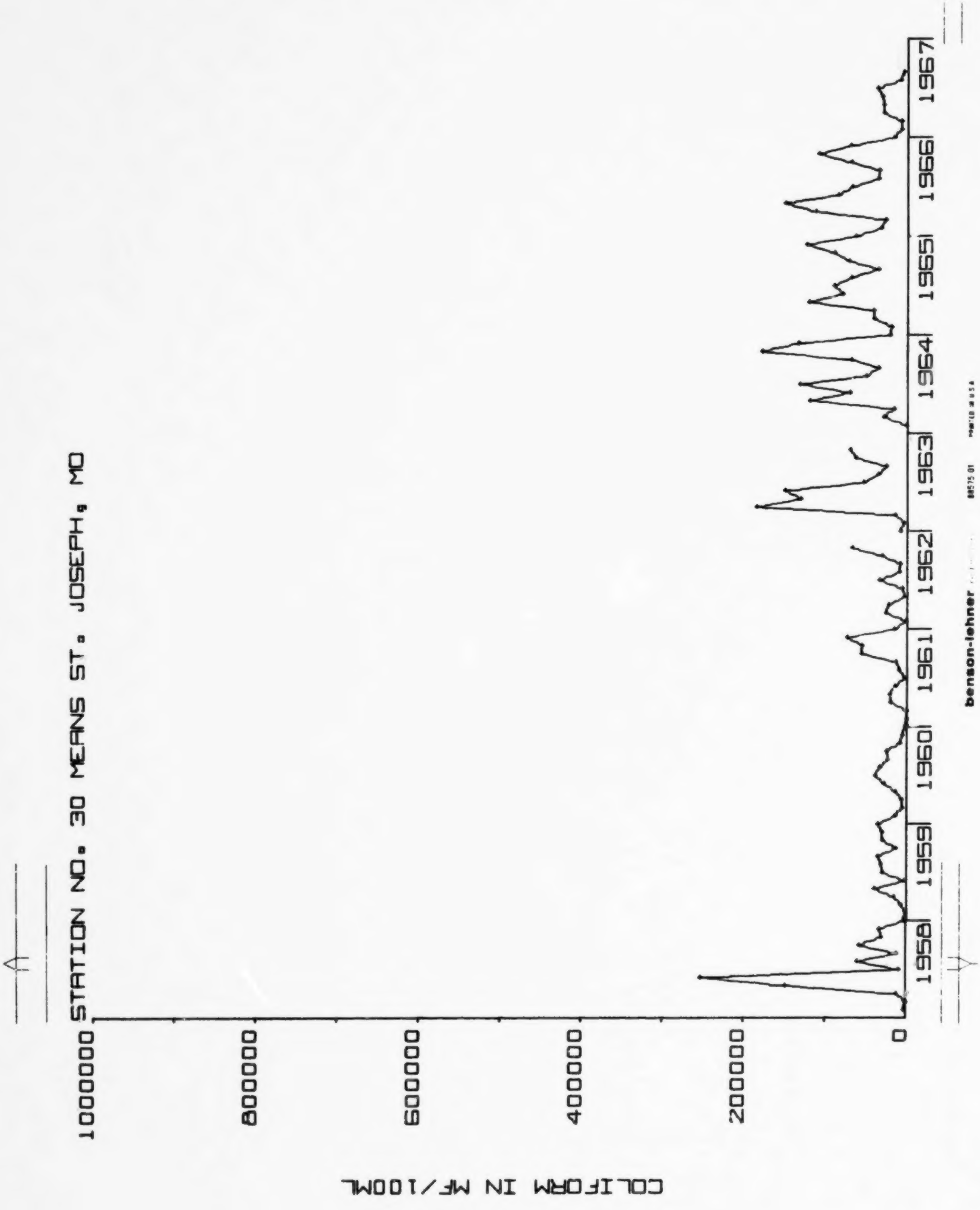


STATION NO. 31 MAX OMAHA, NEBR.

benson-lehner

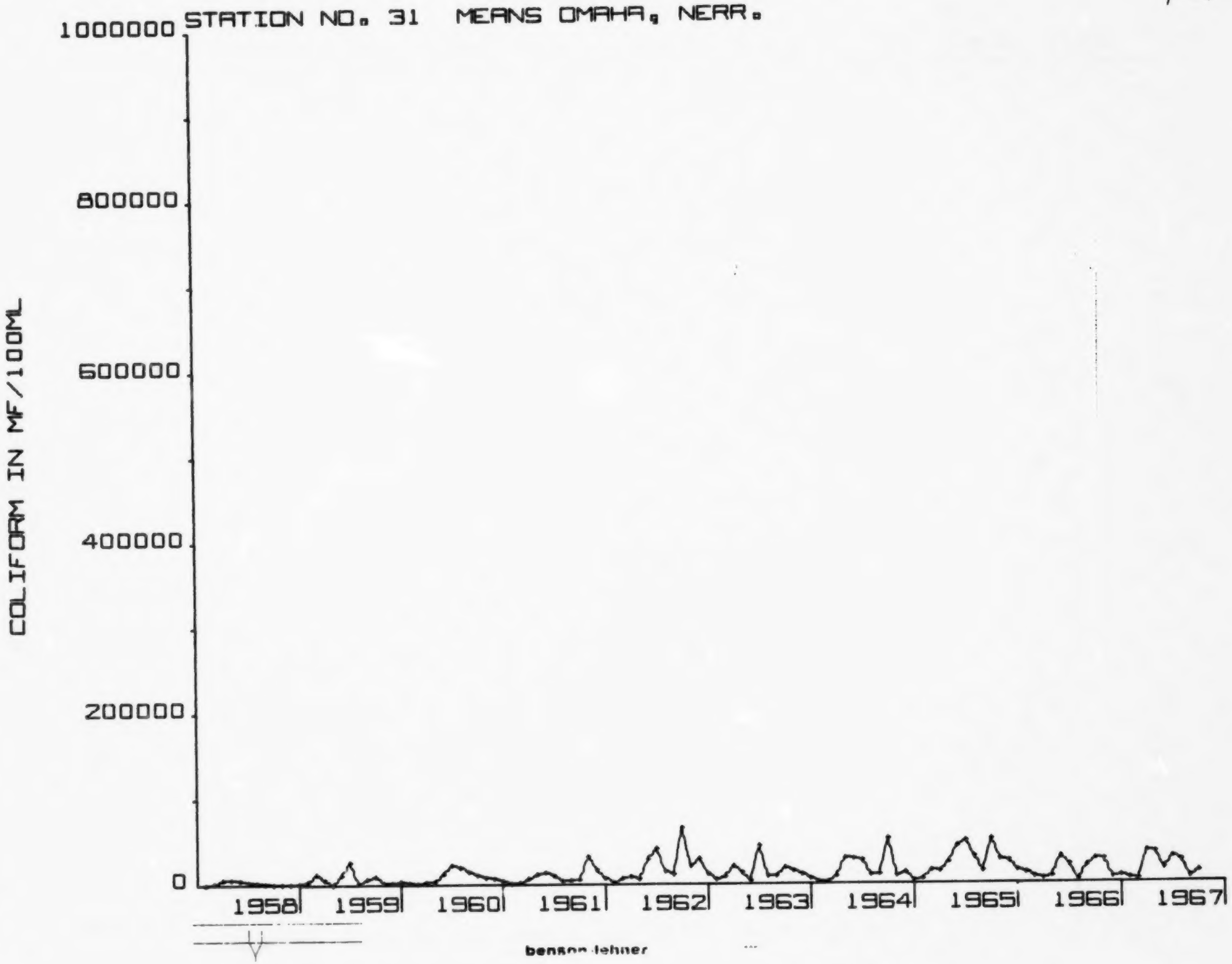
f--7-


STATION NO. 32 MAX. [redacted]
Yankton, S.D.
COLIFORM IN MF/100ML
1000000
800000
600000
400000
200000
0
1958
1959
1960
1961
1962
1963
1964
1965
1966
1967
benson-lehner

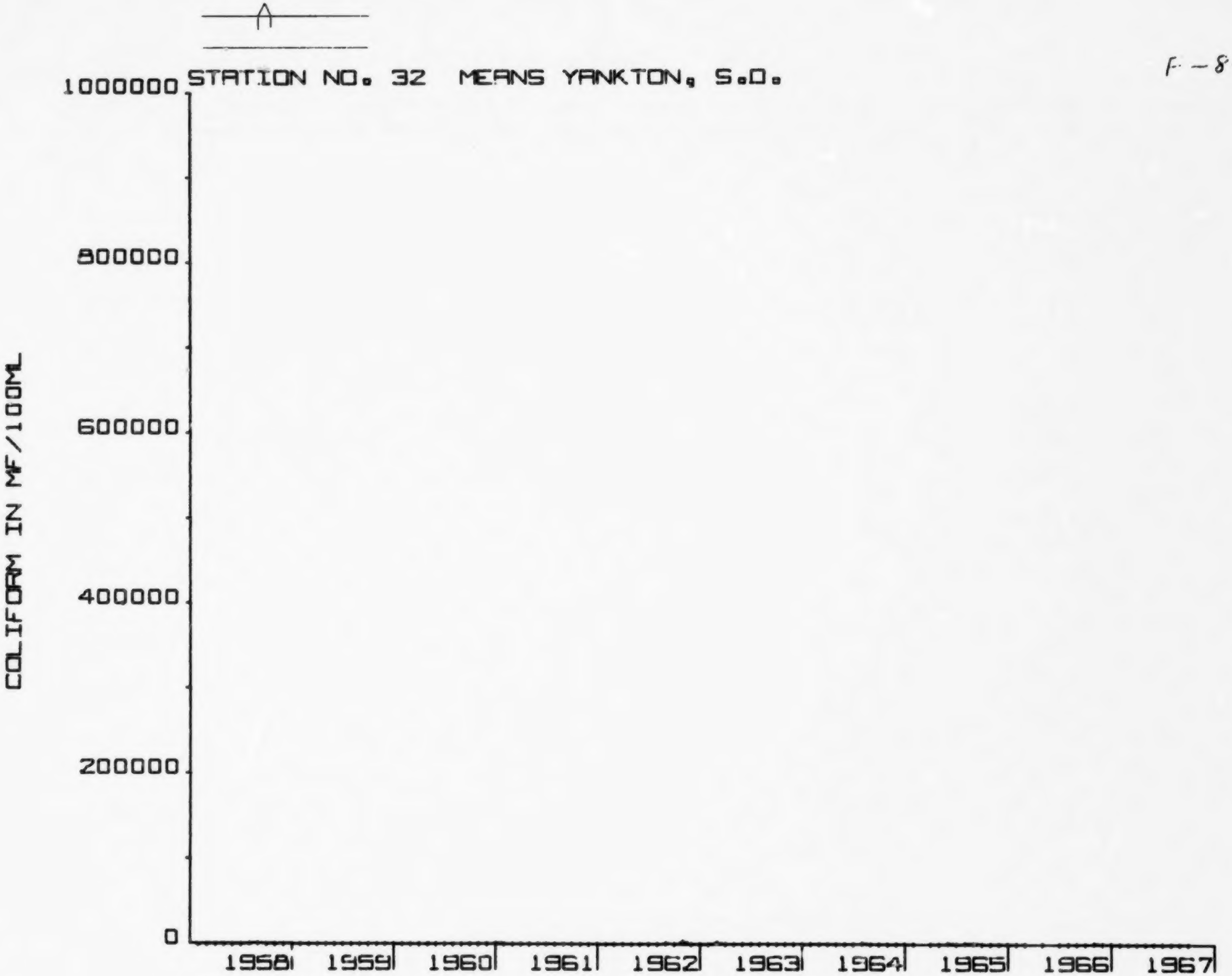


STATION NO. 30 MEANS ST. JOSEPH, MO

F-8-0

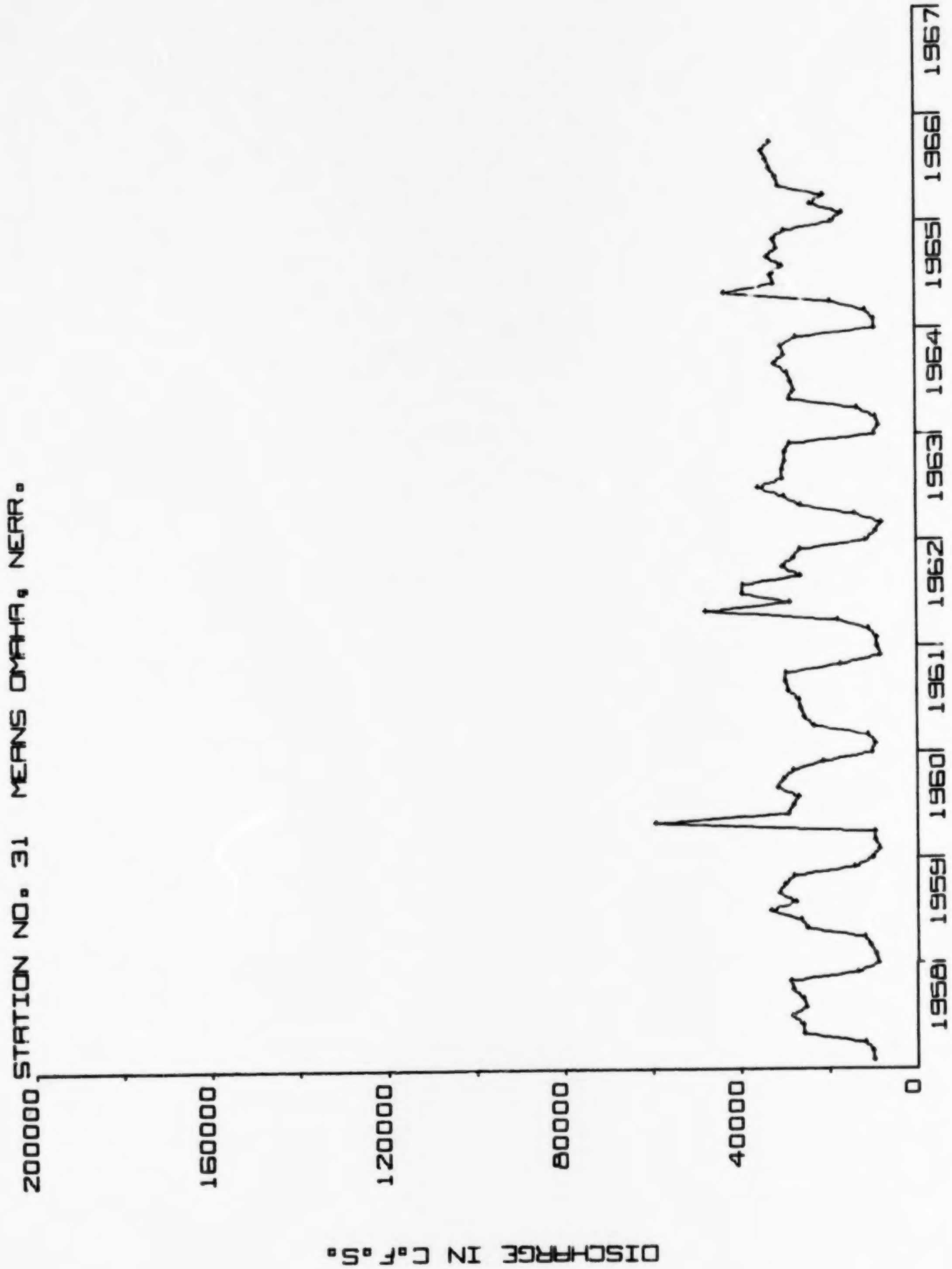

STATION NO. 31 MEANS OMAHA, NEBR.

F-8-Y

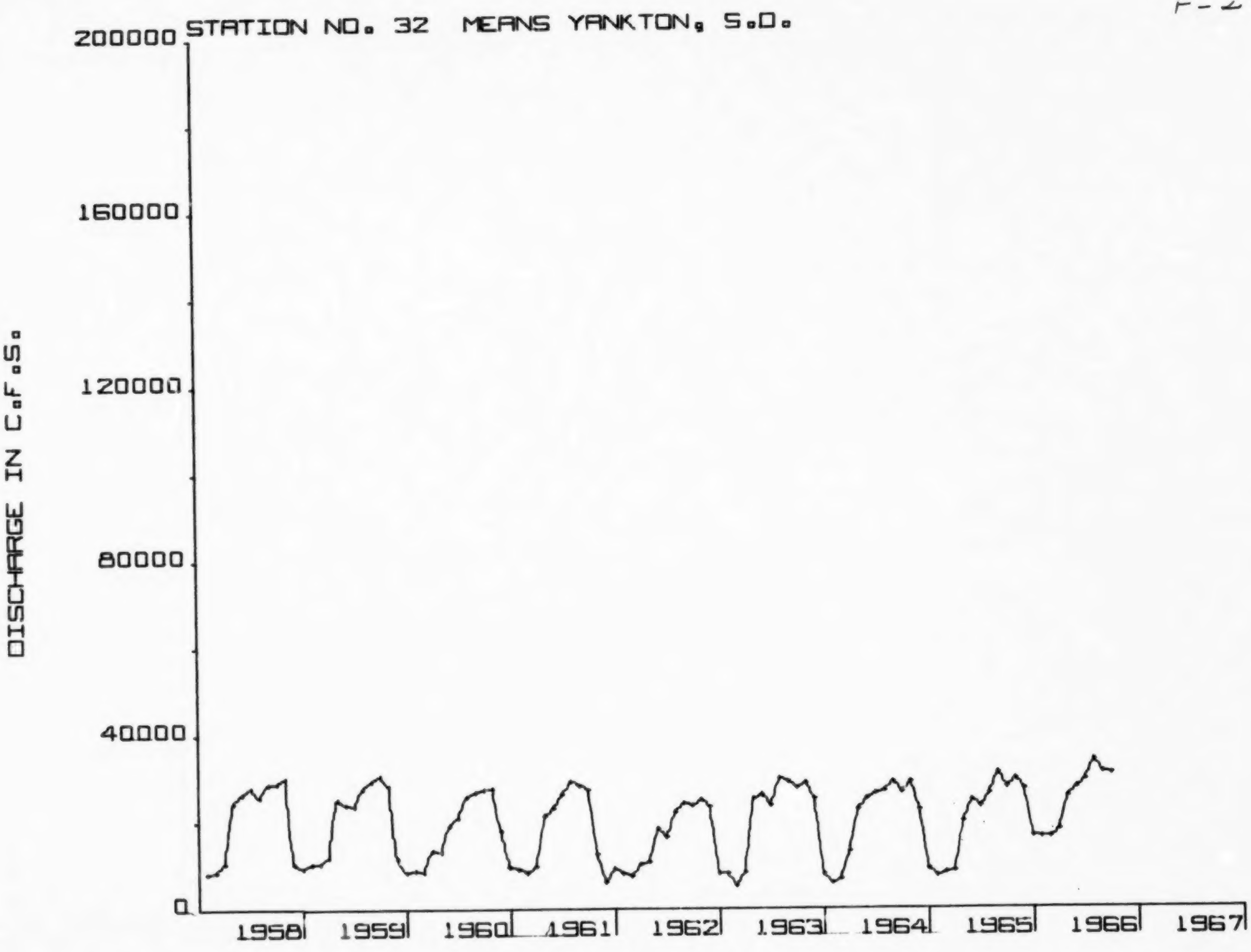


STATION NO. 32 MEANS YANKTON, S.D.

benson-lehner 88575-01 PRINTED IN U.S.A.


STATION NO. 31 MEANS OMAHA, NEBR.
DISCHARGE IN C.F.S.
200000
160000
120000
80000
40000
0
1958
1959
1960
1961
1962
1963
1964
1965
1966
1967

F-2.

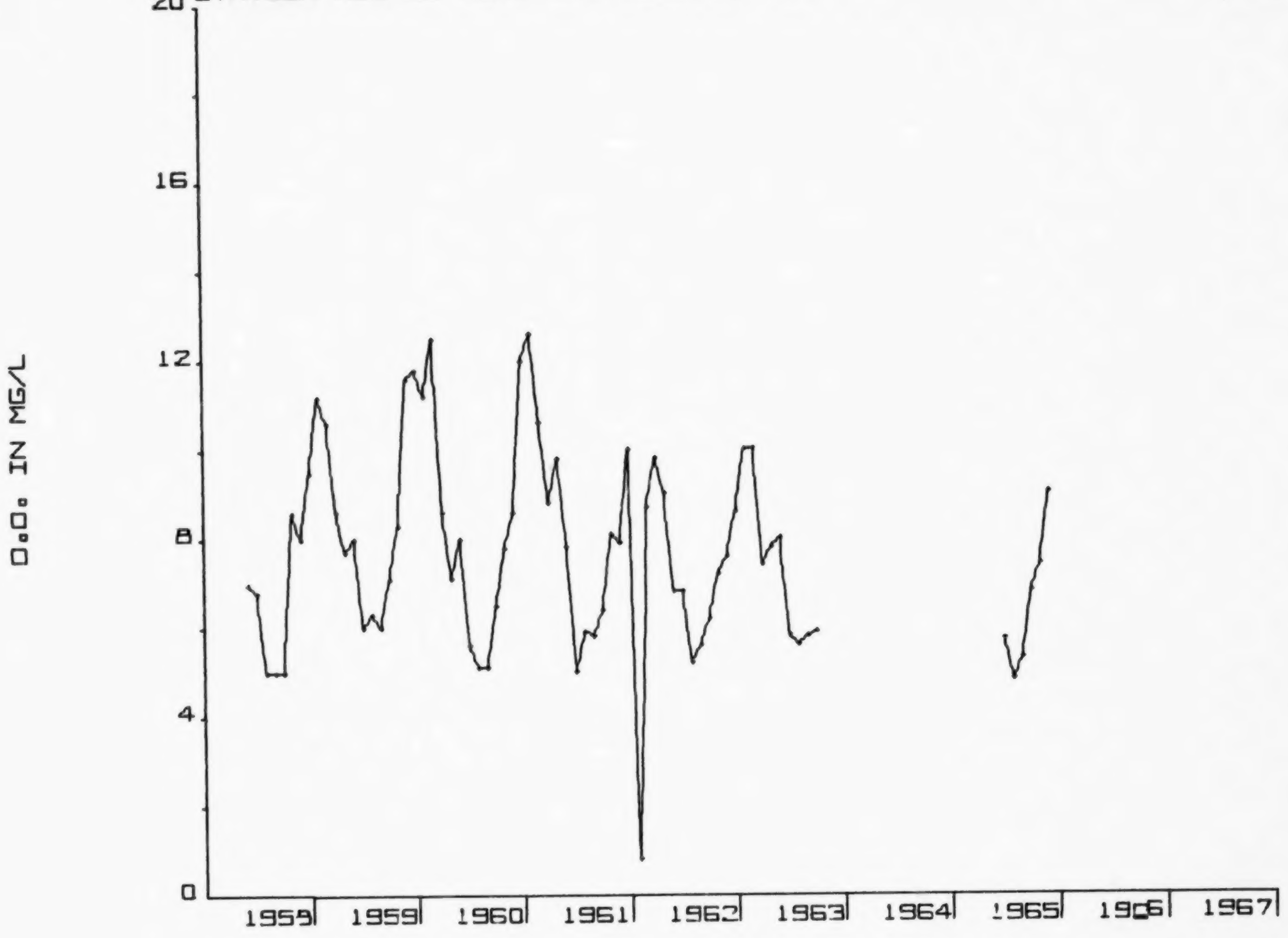

STATION NO. 32 MEANS YANKTON, S.D.

benson-lehner corporation 88575-01 PRINTED IN U.S.A.

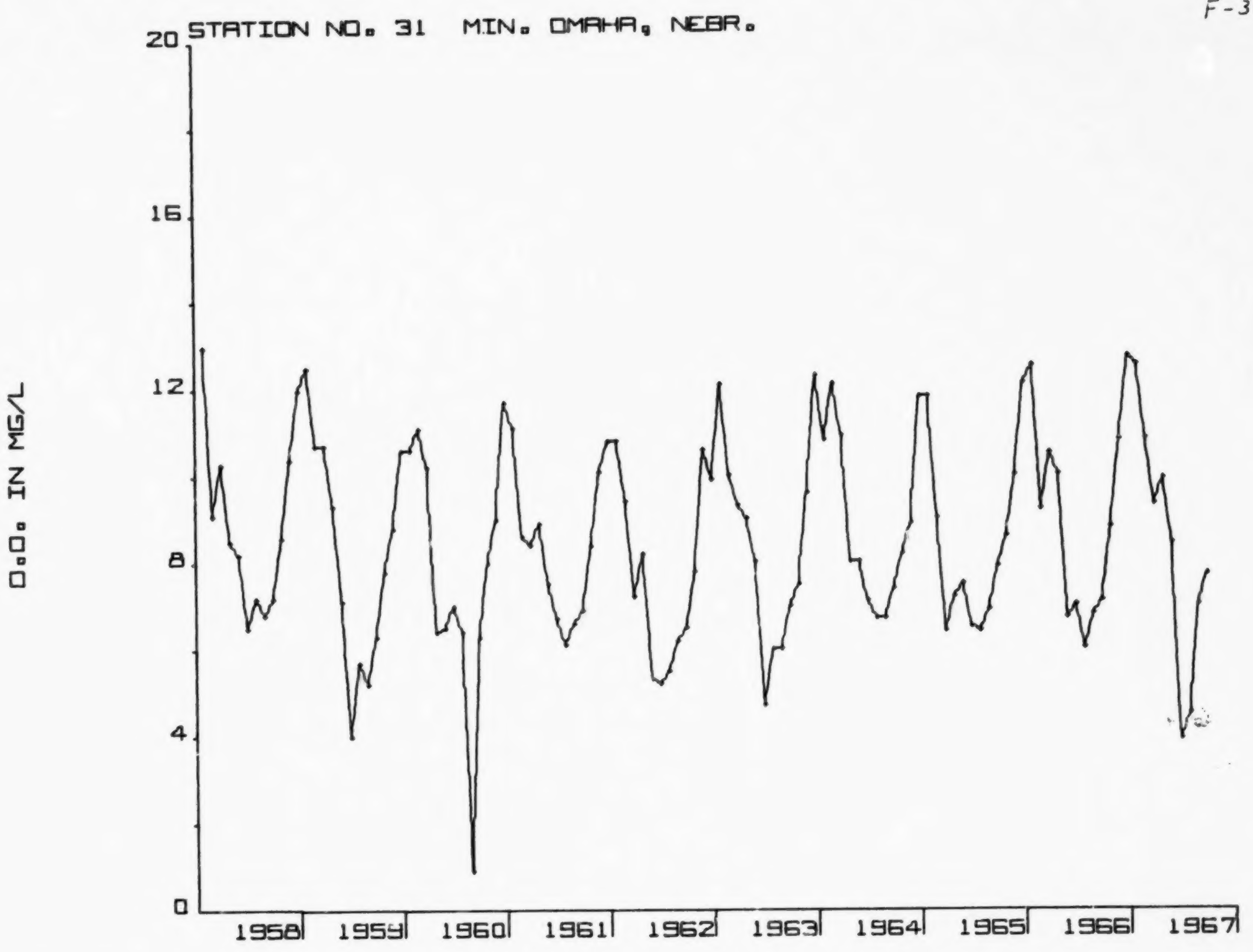
benson-lehner 88575-01

STATION NO. 30 MIN. ST. JOSEPH, MO.

F-3-5

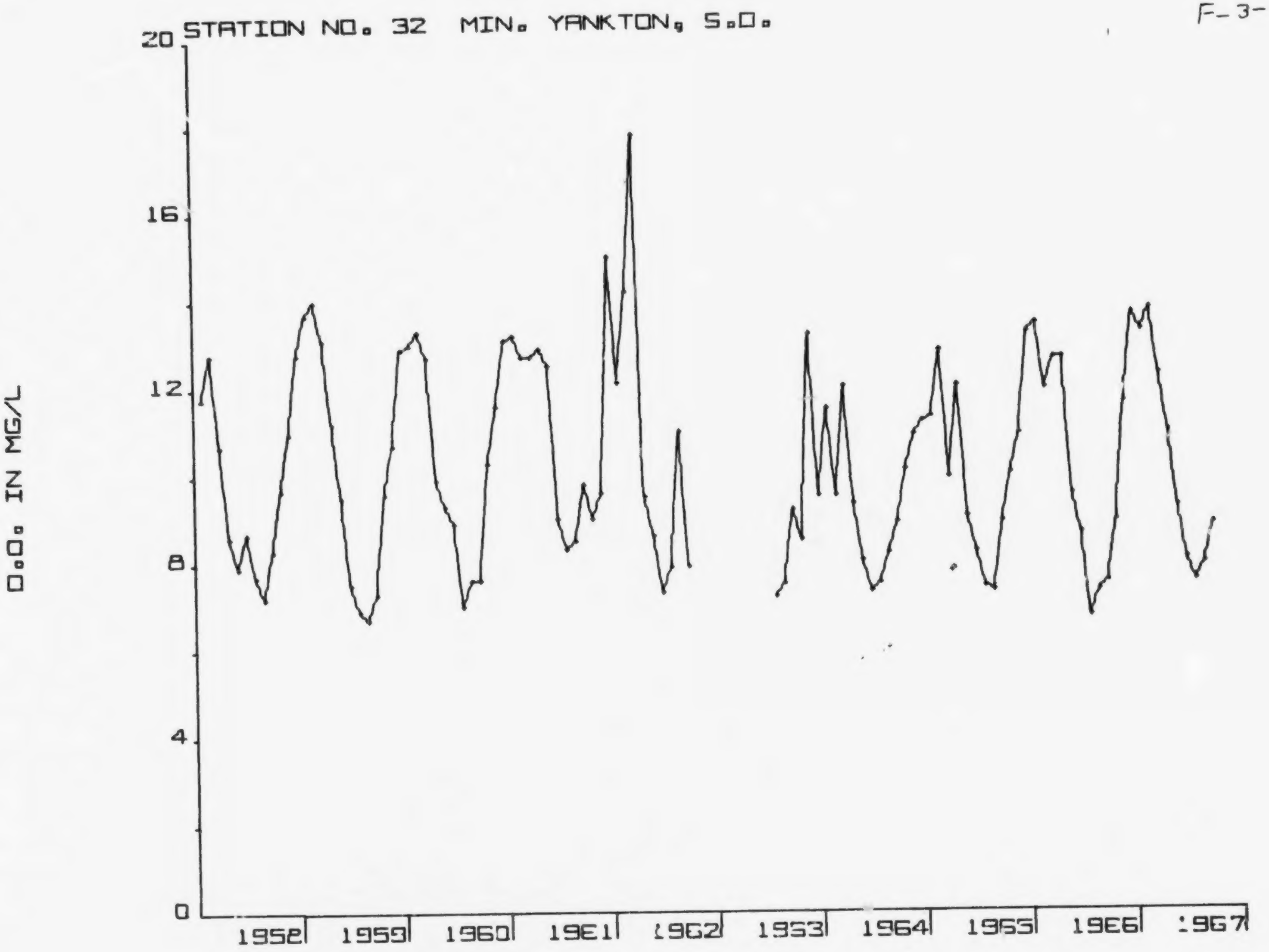


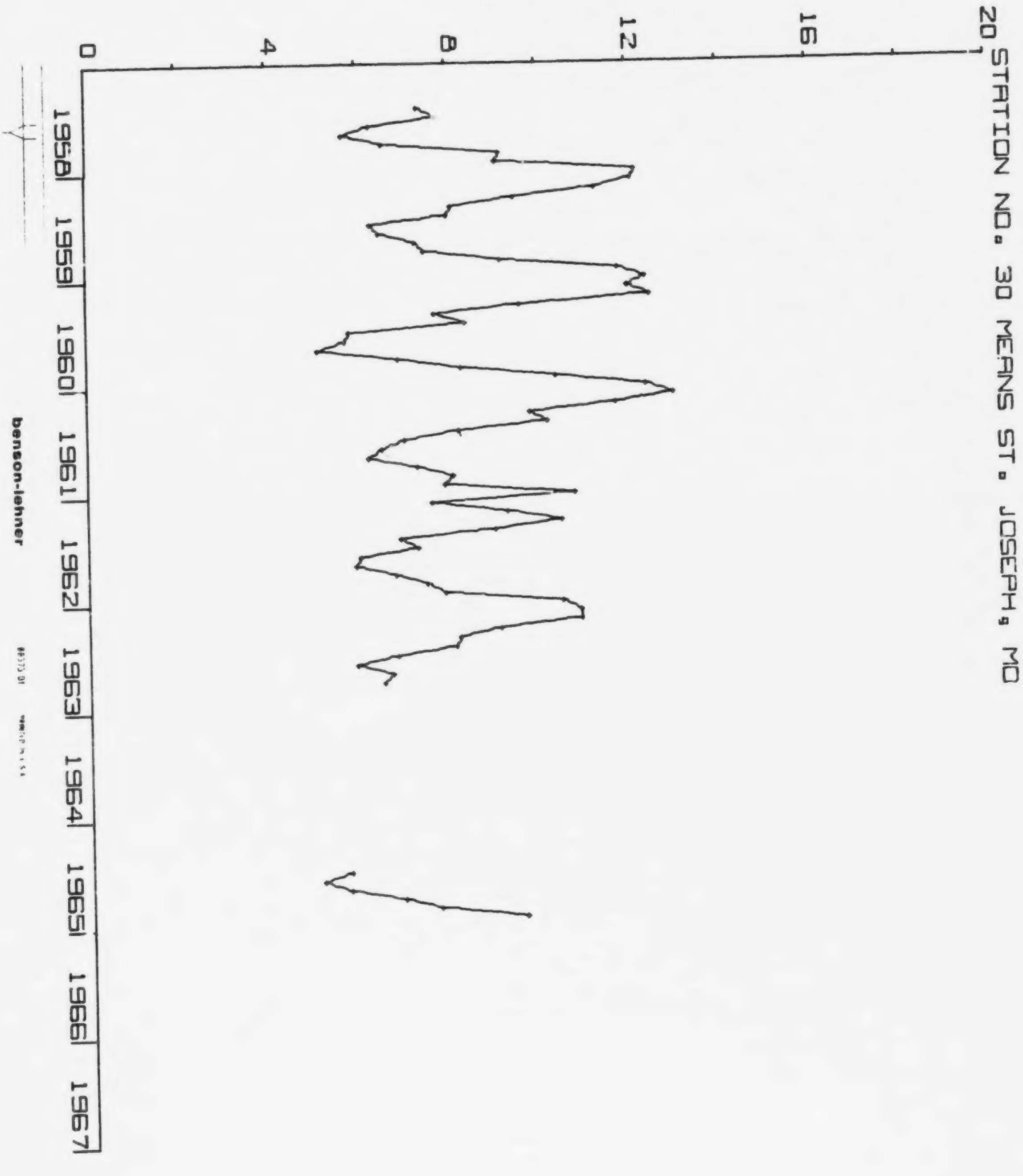
F-3


STATION NO. 31 MIN. OMAHA, NEBR.

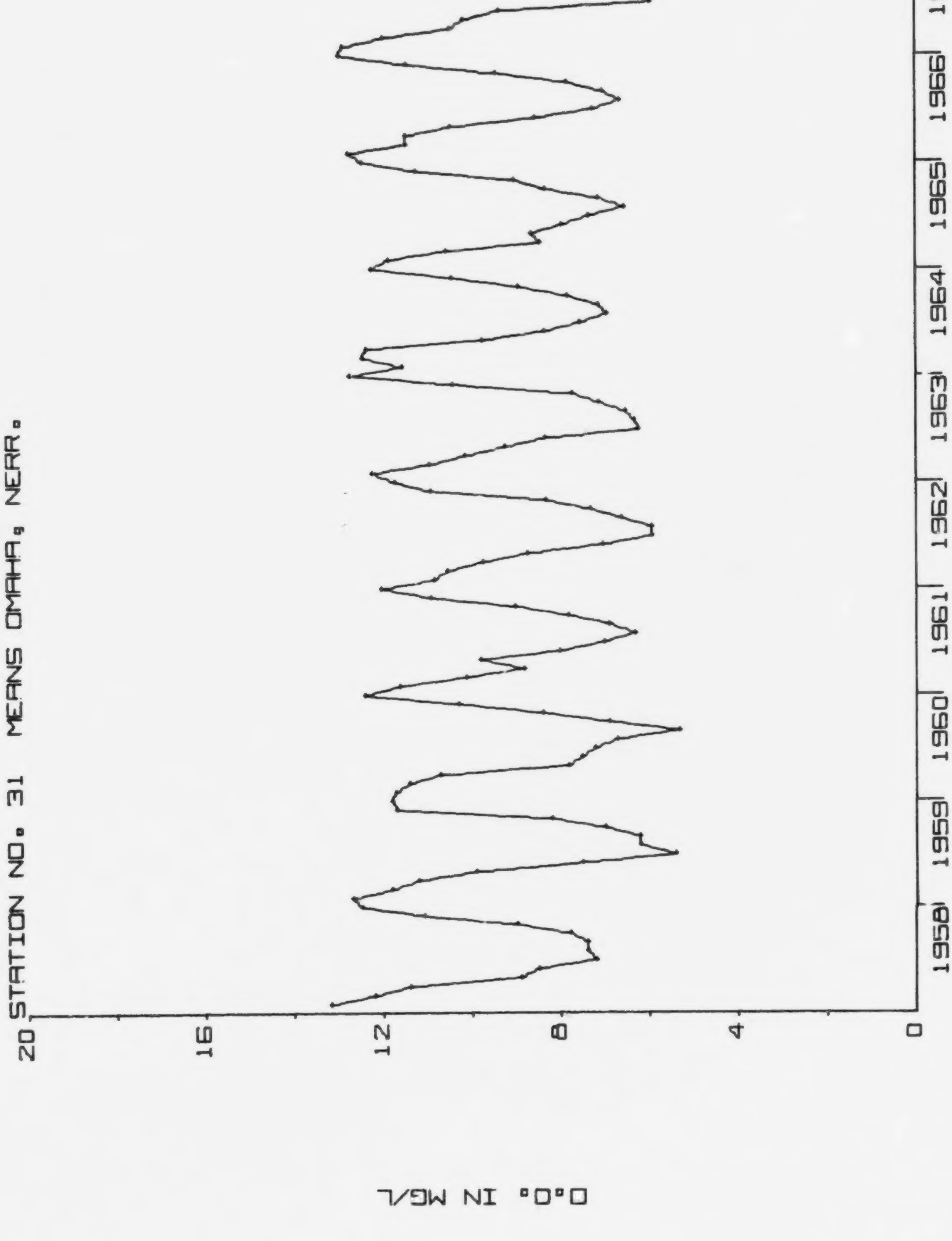
00575-31 PRINTED IN U.S.A.
benson-lehner 00575-31 PRINTED IN U.S.A.

F-3-Y


STATION NO. 32 MIN. YANKTON, S.D.
D.O. IN MG/L
20
16
12
8
4
0
1958
1959
1960
1961
1962
1963
1964
1965
1966
1967

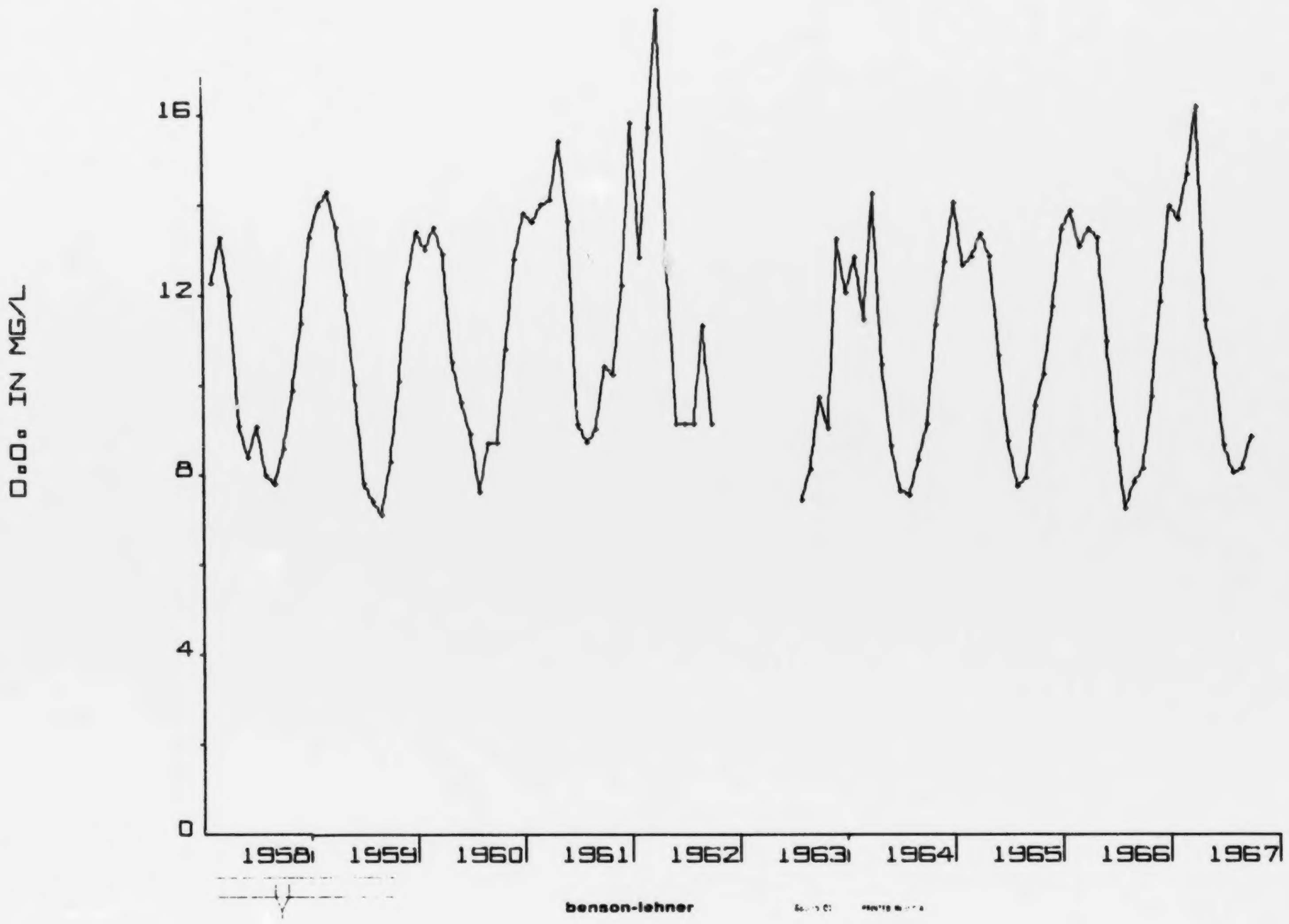

STATION NO. 30 MEANS ST. JOSEPH, MO
D.O. IN MG/L
0
4
8
12
16
20
1958
1959
1960
1961
1962
1963
1964
1965
1966
1967
benson-lehner

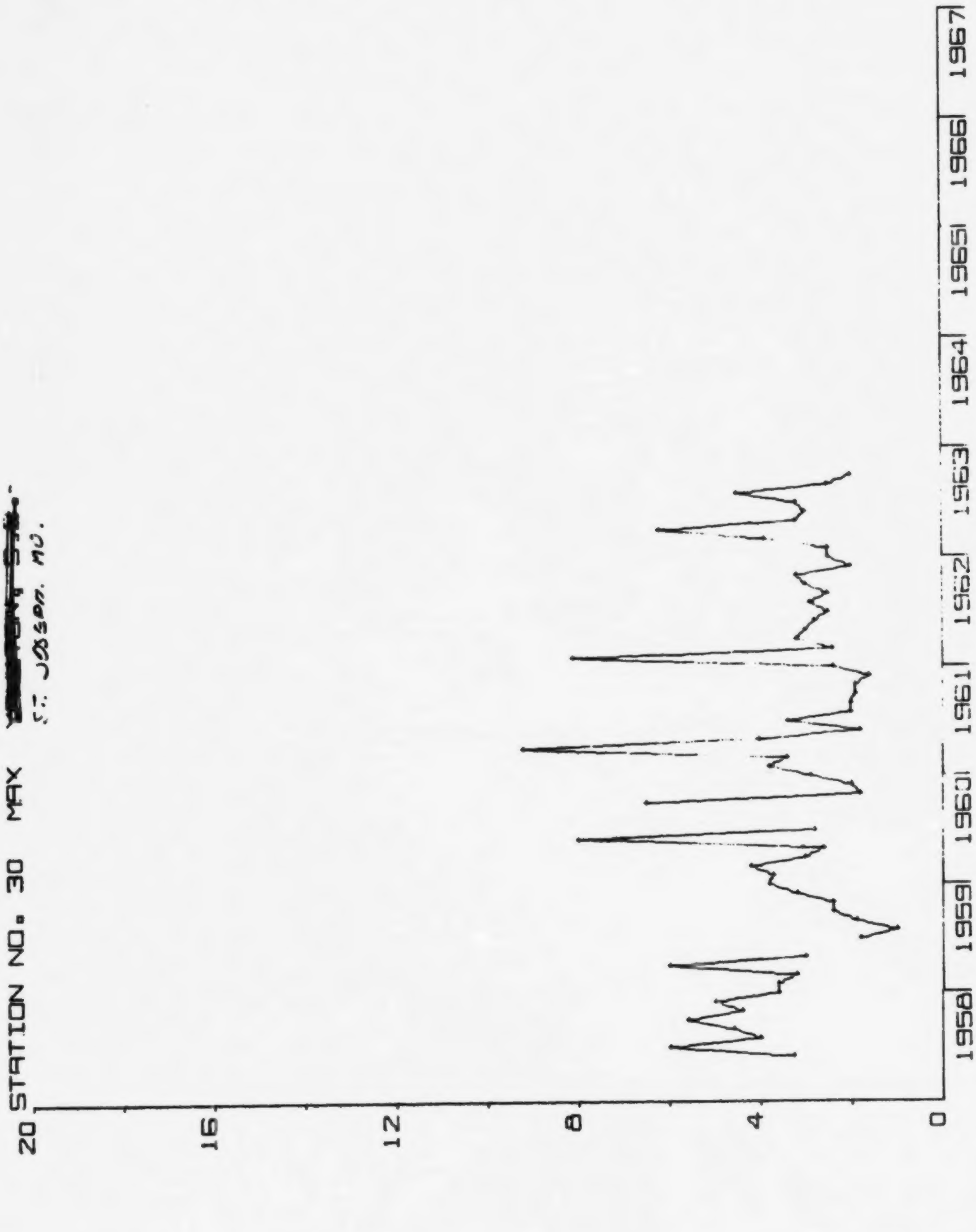
F-4-0

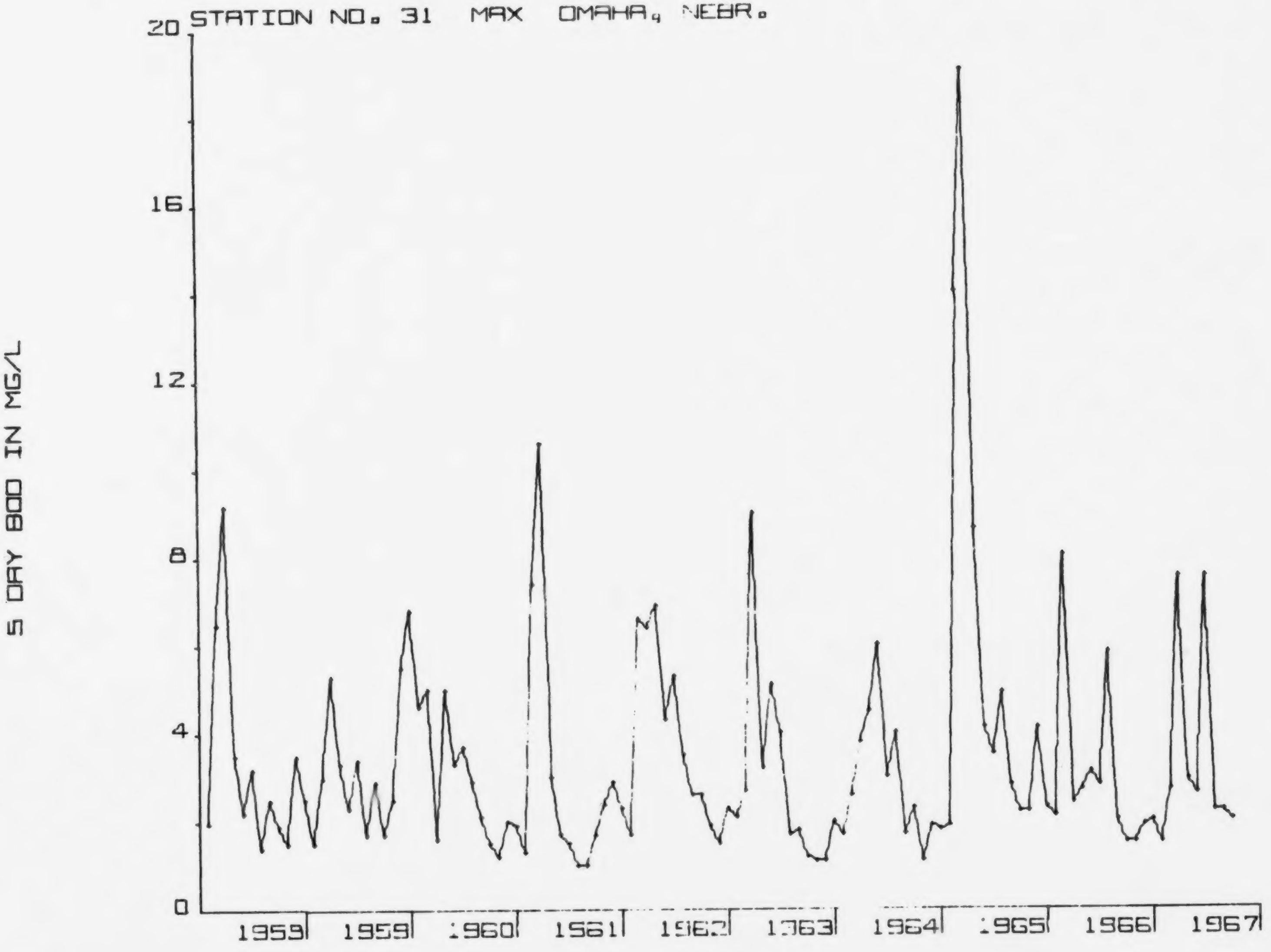

STATION NO. 31 MEANS OMAHA, NEBR.
D.O. IN MG/L
20
16
12
8
4
0
1958
1959
1960
1961
1962
1963
1964
1965
1966
1967

F-4-

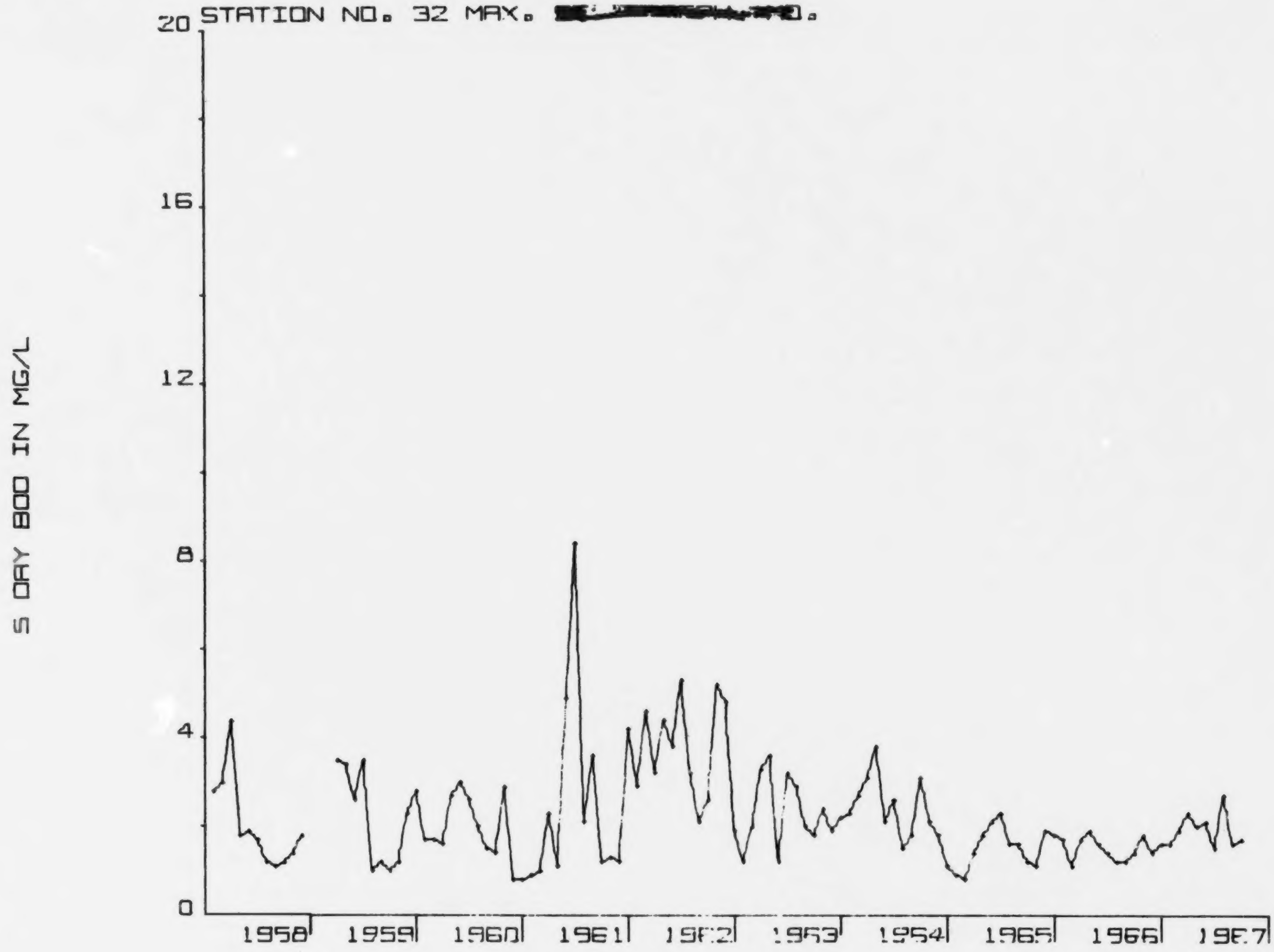
STATION NO. 32 MEANS YANKTON, S.D.

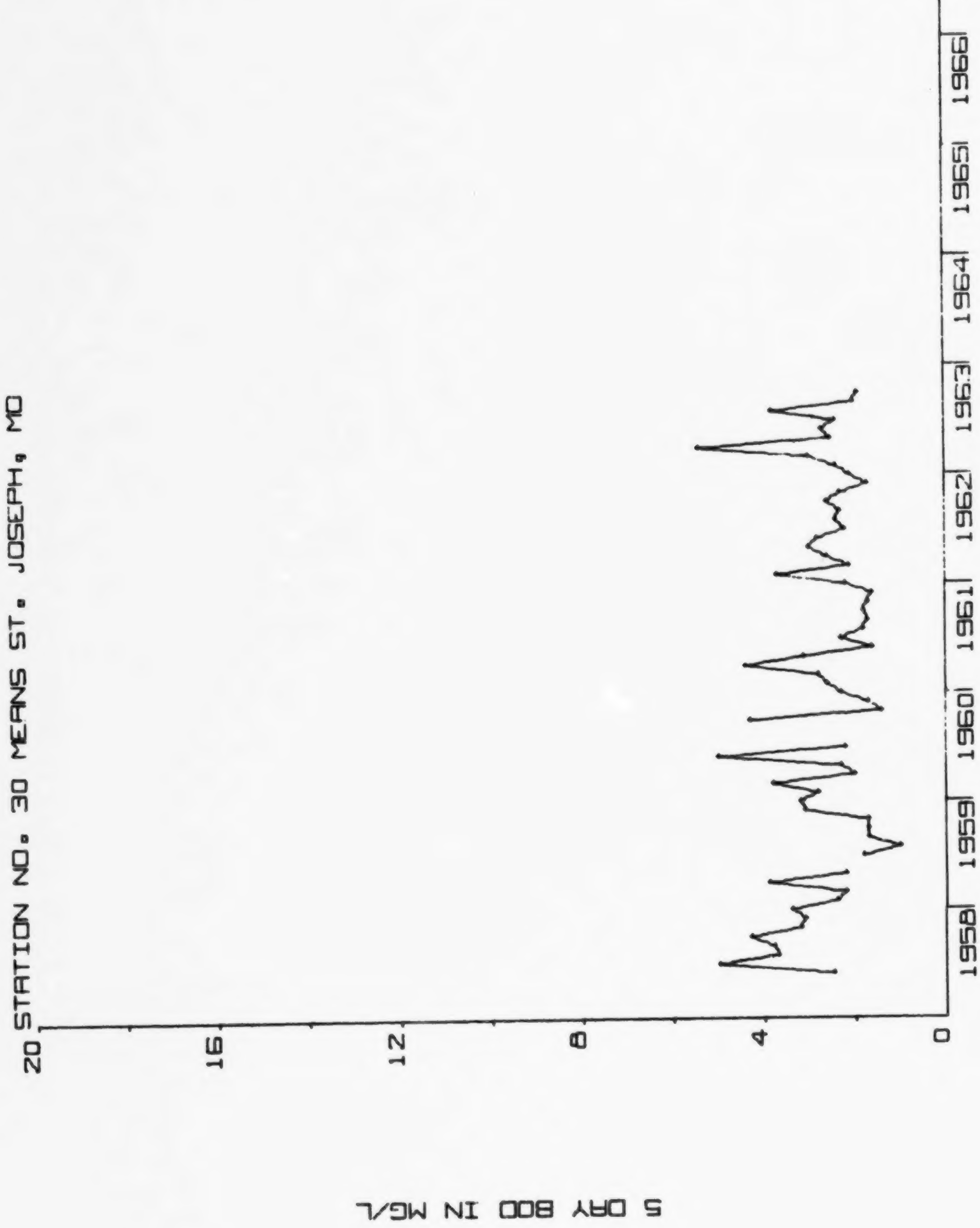


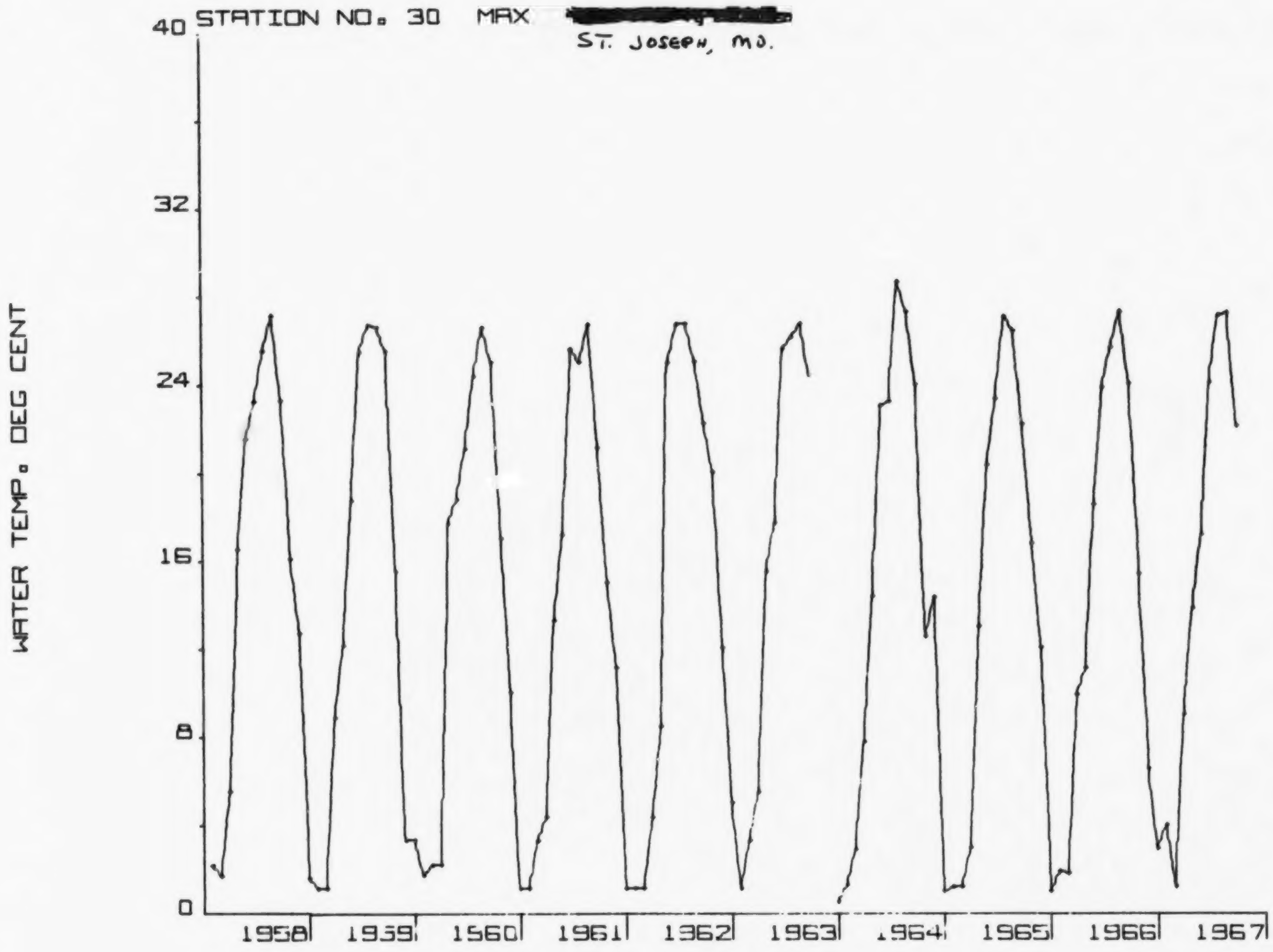

STATION NO. 30 MAX
[redacted]
ST. JOSEPH, MO.
5 DAY BOD IN MG/L
20
16
12
8
4
0
1958
1959
1960
1961
1962
1963
1964
1965
1966
1967

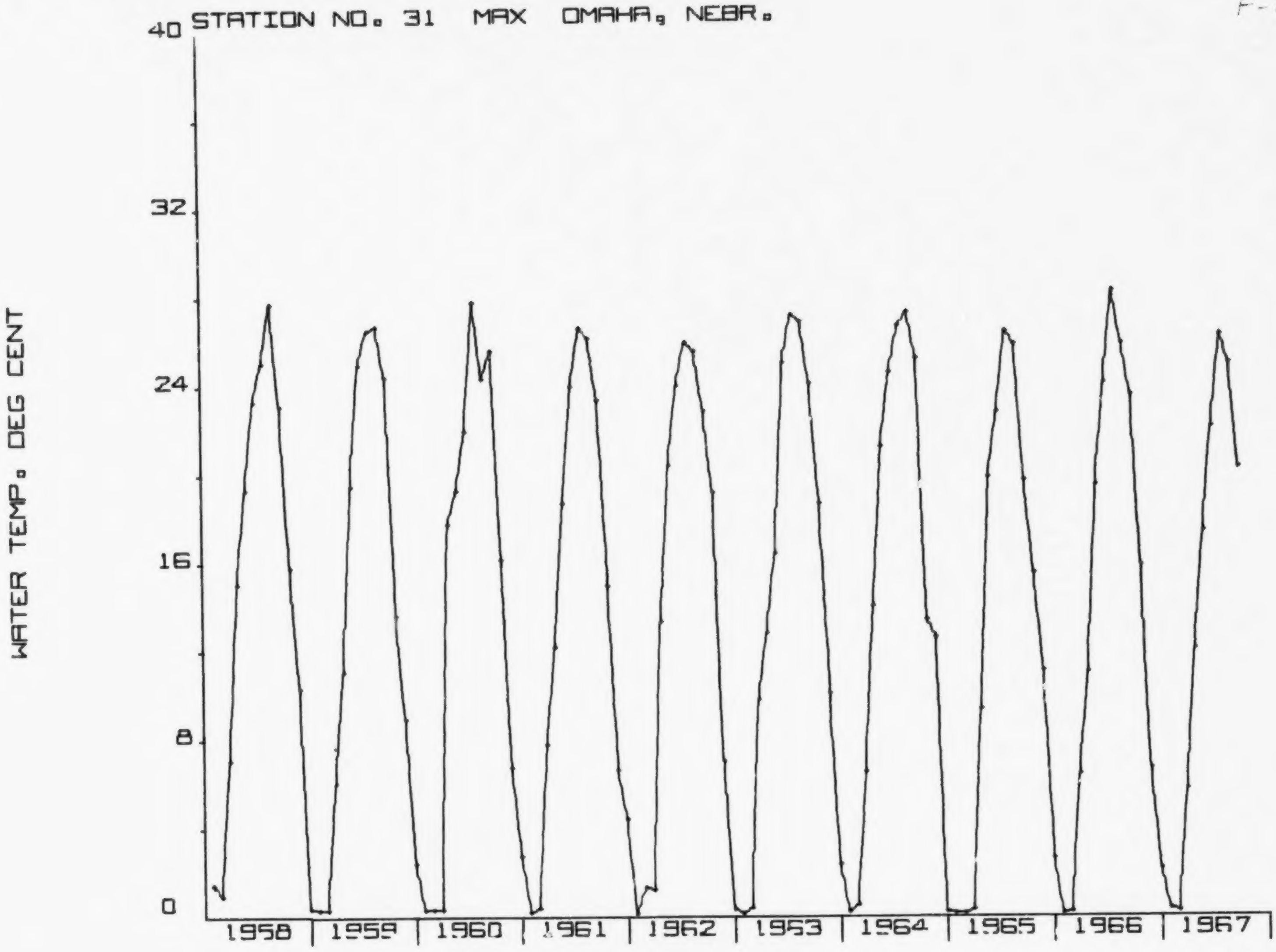


benson-lehner


STATION NO. 32 MAX. [redacted].
5 DAY BOD IN MG/L
20
16
12
8
4
0
1958
1959
1960
1961
1962
1963
1964
1965
1966
1967


STATION NO. 30 MEANS ST. JOSEPH, MO
5 DAY BOD IN MG/L
20
16
12
8
4
0
1958
1959
1960
1961
1962
1963
1964
1965
1966
1967

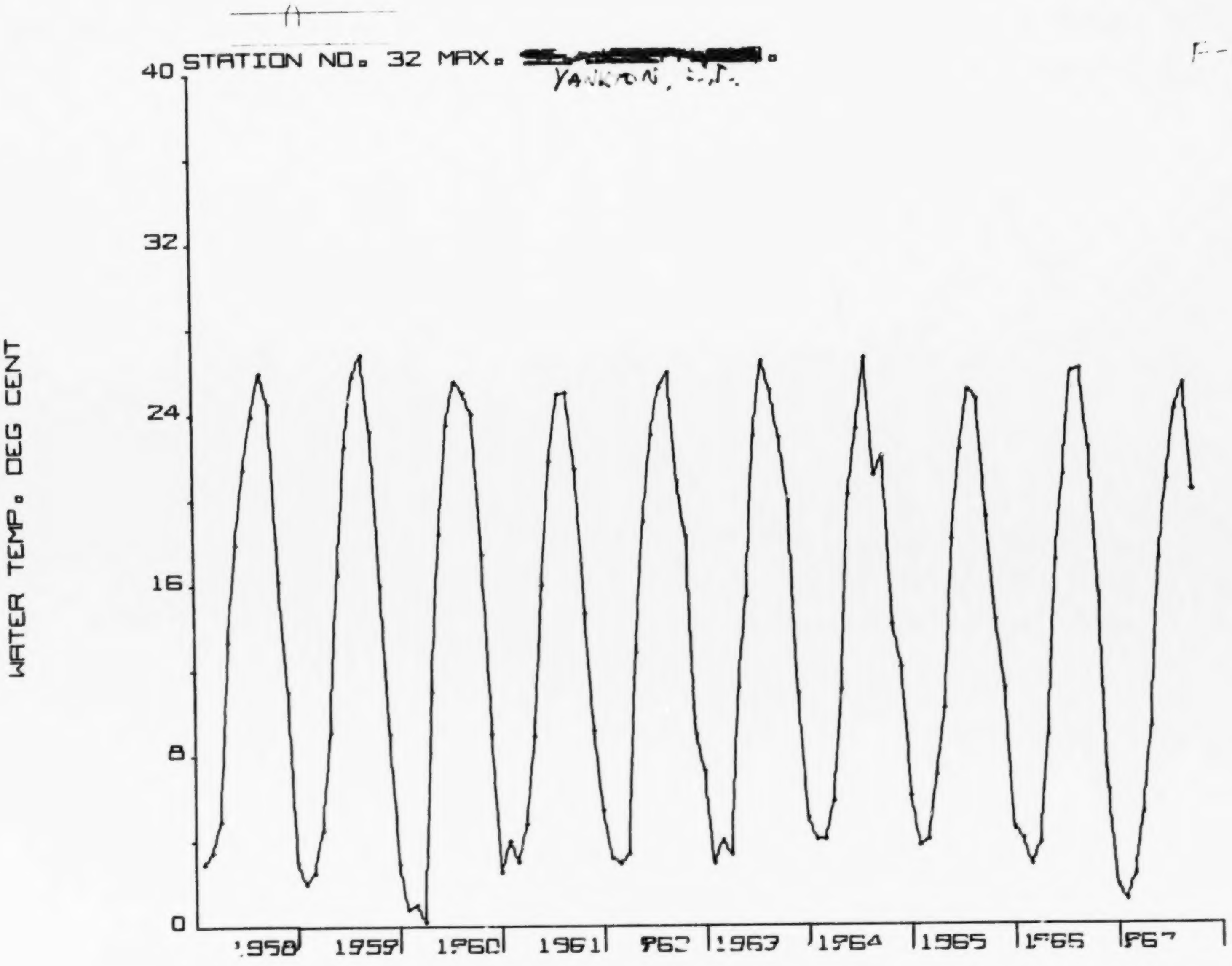

STATION NO. 30 MAX [redacted]
ST. JOSEPH, MO.
WATER TEMP. DEG CENT
40
32
24
16
8
0
1958
1959
1960
1961
1962
1963
1964
1965
1966
1967



STATION NO. 31 MAX OMAHA, NEBR.

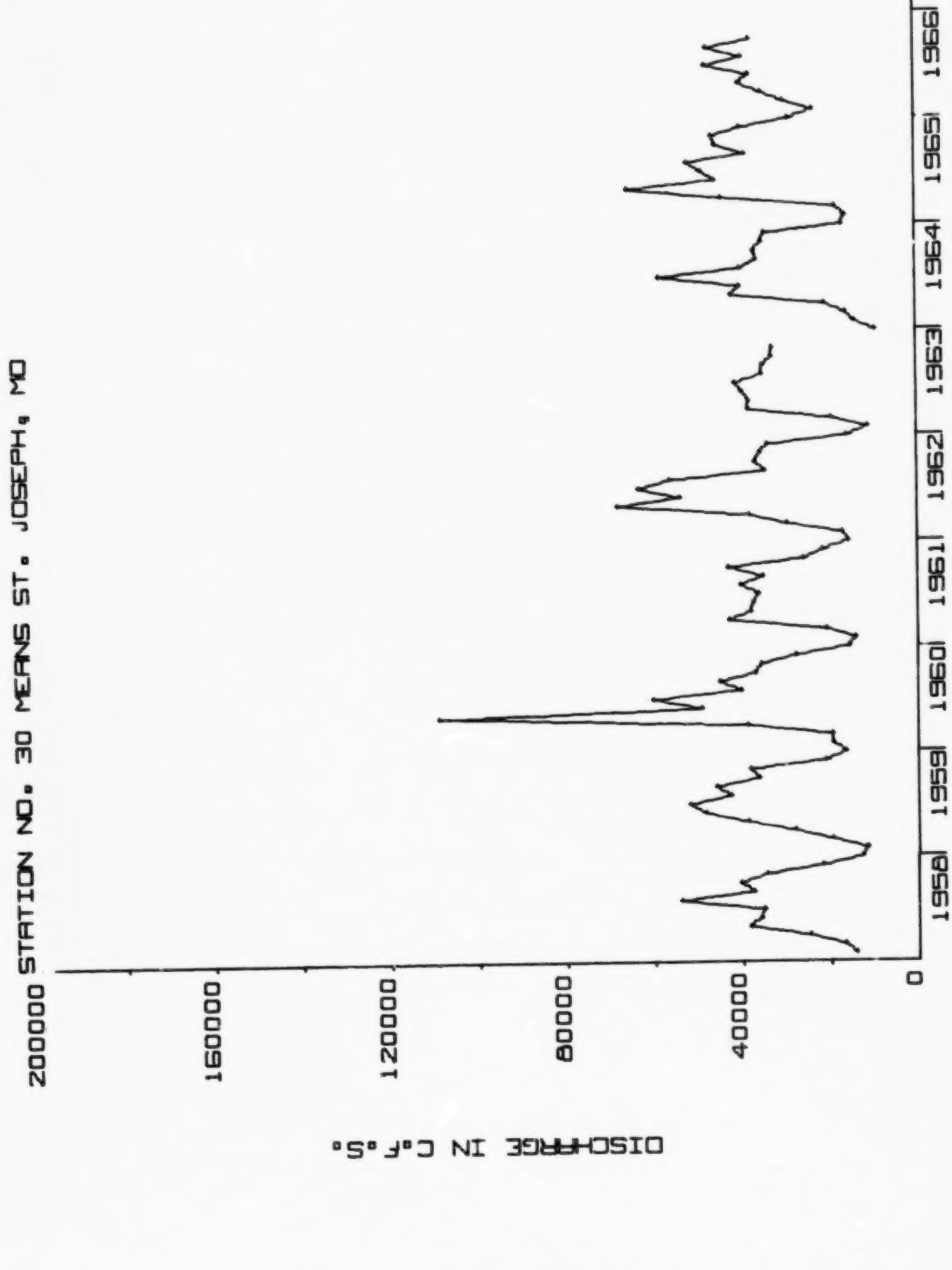
benson-lehner

F-1-Y



STATION NO. 32 MAX. [redacted].
YANKTON, S.D.

benson-lehner



STATION NO. 30 MEANS ST. JOSEPH, MO

benson-lehner corporation

benson-lehner

APPENDIX G

WATER USES - RECOGNIZED BY THE STATE OF IOWA

G. Water Uses - Recognized By The State of Iowa

(Missouri River--bordering Iowa)

Uses

1. Public Water Supply (Council Bluffs only)
2. Aquatic Life--warm water area (full length of River)

Criteria

General Criteria. The following criteria are applicable to all surface waters at all places and at all times:

a. Free from substances attributable to municipal, industrial or other discharges that will settle to form putrescent or otherwise objectionable sludge deposits;

b. Free from floating debris, oil, scum and other floating materials attributable to municipal, industrial or other discharges in amounts sufficient to be unsightly or deleterious;

c. Free from materials attributable to municipal, industrial or other discharges producing color, odor or other conditions in such degree as to be detrimental to legitimate uses of water;

d. Free from substances attributable to municipal, industrial or other discharges in concentrations or combinations which are detrimental to human, animal, industrial, agricultural, recreational, aquatic or other legitimate uses of the water.

Public Water Supply--Specific Criteria. The following criteria for surface water quality apply to the point at which water is withdrawn for treatment and distribution as a potable supply (Council Bluffs water intake):

1. Bacteria: Waters shall be considered to be of unsatisfactory bacteriological quality as a source when:

   A sanitary survey indicates the presence or probability of the presence of sewage or other objectionable bacteria-bearing wastes or

   A bacteriological survey using coliform or other appropriate indices indicates bacteriological concentrations significantly higher than those normally found or expected in these waters when free from pollution by sewage.

2. Radioactive substances: Gross beta activity (in the known absence of strontium - 90 and alpha emitters) not to exceed 1000 micro-microcuries per liter.

3. Chemical constituents: Not to exceed the following concentrations:

Specific Constituents (mg/l)

Arsenic	0.05	Cyanide	0.025
Barium	1.0	Fluoride	1.5
Cadmium	0.01	Lead	0.05
Chromium (hexavalent)	0.05	Phenols	0.02

All substances toxic or detrimental to humans or detrimental to treatment processes shall be limited to nontoxic or nondetrimental concentrations in the surface water.

Aquatic Life--Specific Criteria. The following criteria are designed for the maintenance and propagation of a well-balanced fish population. They are applicable to any place in surface waters but cognizance will be given to opportunities for admixture of waste effluents with such waters.

1. Warm water areas. Dissolved oxygen: Not less than 5.0 mg/l during at least 16 hours of any 24-hour period and not less than 4.0 mg/l at any time during the 24-hour period.

   pH: Not less than 6.8 nor above 9.0.

   Temperature: Not to exceed 93° F during the months of May through November, and not to exceed 73° F during the months of December through April.

   Chemical constituents: Not to exceed the following concentrations:

Specific constituents (mg/l)

Ammonia Nitrogen (N)	2.0	*Copper	0.02
*Arsenic	1.0	Cyanide	0.025
*Barium	5.0	*Lead	0.10
*Cadium	0.05	Phenols	0.20
*Chromium (hexavalent)	0.05	*Zinc	1.0
*Chromium (trivalent)	1.00		

*A maximum of 5.0 mg/l for the entire heavy metal group shall not be exceeded.

All substances toxic or detrimental to aquatic life shall be limited to nontoxic or nondetrimental concentrations in the surface water.

245-B

APPENDIX H

INVESTIGATION OF BACTERIOLOGICAL WATER QUALITY OF THE MISSOURI RIVER IN OCTOBER 1968

I. INTRODUCTION

The following analysis was made on the 8-day, dry weather, navigation flow, data presented in Table A-I and Table A-4 of this report. The effort was directed at determining the sources of bacteriological contamination to the Missouri River and at predicting the effect of treatment on these sources. Figure H-1 shows the coliform concentrations.

II. METHOD OF ANALYSIS

The coliform data on the Missouri River from Gavins Point to St. Jospeh were evaluated in terms of a coliform mass (i.e., the data were evaluated from a total number per day approach rather than a concentration approach). The coliform masses were calculated for the various sources along the reach of the Missouri River from Gavins Point to St. Joseph. These coliform source data included measurements of the waste effluents at the Sioux City Sewage Treatment Plant, the Council Bluffs Sewage Treatment Plant, the Monroe Street Sewer at Omaha, Nebraska, and estimates of the densities in the remaining outfalls from Omaha and Papillion Creek. Also included were the measurements of coliform densities from the major tributaries.

A mass diagram of the data is shown in Figure H-2. The mass diagram indicated that the major sources of coliforms in the Missouri during the dry weather period of the October survey were contributed by major cities. The coliform contribution to the Missouri River from the Big Sioux River, the Soldier River, and the Boyer River was negligible during the normal flow period of the October survey. These observations led to the next portion of the analysis.

Based on the field observations, the major source of coliforms are from the wastewater effluents. Consequently, an analysis was made to determine the effect of treatment on reducing the quantity of coliforms in the Missouri River. This analysis was based on the work of Imhoff and Fair (1) and Kittrell and Furfari (2). A 93 per cent reduction of coliform was assumed with secondary treatment and a 98.5 per cent reduction of coliform was assumed with secondary treatment and chlorination. The predicted effects of these types of treatment on river coliform concentrations are shown in Figure H-3 and are tabulated in Table H-I.

III. OTHER ANALYSES MADE

A mass balance was also made on the fecal coliform organisms. The results showed that approximately 50 per cent of the fecal coliforms in the river could be accounted for in the reach from Sioux City to Omaha. This includes only those fecal coliforms measured at the Sioux City Sewage Treatment Plant. It does not include coliform organisms that may have been contributed from the other waste sources in the Sioux City area. Greater than 75 per cent of the fecal coliform organisms could be accounted for in the reach of the river from Omaha to St. Joseph.

The effect of two stage chlorination with primary treatment on coliform densities was also calculated. Pierce (3) concluded that with two stage chlorination, coliform densities in a plant effluent could be reduced consistently to a concentration of 500 MPN/100 ml or lower. This reduction is far in excess of the 98.5 per cent reduction assumed for secondary treatment with chlorination. This effluent concentration would virtually eliminate the effect of the major cities on the river coliform concentration. If this reduction were realized, the major sources of bacterial contamination would have been the Boyer River and the Platte River. This conclusion is based on conditions existing in the river that were similiar to those in the October

1968 survey. The maximum value of coliform concentration in the river assuming two stage chlorination and primary treatment was estimated to be 4250 MPN/100 ml.

IV. CONCLUSIONS

The following conclusions are based on the above analyses and apply to the Missouri River conditions that existed during the dry weather period of the October 1968 survey.

1. Greater than 85 per cent of the total coliforms measured in the Missouri River were contributed by the major waste sources along the stream.
2. Approximately 50 per cent of the fecal coliforms measured in the Missouri River were contributed by the major waste sources that were measured during the October 1968 survey.
3. The total and fecal coliform contribution to the Missouri River from the Big Sioux River, the Soldier River and the Boyer River were negligible during the dry weather period of the October survey.
4. Secondary treatment alone would not be adequate to provide reduction of coliforms to meet the National Technical Advisory Committee's standard for public water supplies based on the analysis outlined above.
5. Chlorination following secondary treatment would be adequate to provide reduction of coliforms to meet the National Technical Advisory Committee's standard for public water supplies based on the analysis outlined above.

6. Primary treatment with two stage chlorination would be adequate to provide reduction of coliforms to meet the National Technical Advisory Committee's standard for public water supplies based on the analysis outlined above.

BIBLIOGRAPHY

1. Imhoff, K. and G.M. Fair, Sewage Treatment. John Wiley and Sons, Inc., New York (1956).

2. Kittrell, F.W. and S.A. Furfari, "Observations of Coliform Bacteria in Streams." Journal Water Pollution Control Federation. pp. 1361-1385, (November 1963).

3. Pierce, D.M. "Two-Stage Chlorination - An Effective and Practical Method of Sewage Disinfection." Sewage and Industrial Wastes. Vol. 24, No. 8, pp. 929-961, (August 1952).

TABLE H-I

MISSOURI RIVER SURVEY - SUMMARY OF TOTAL COLIFORM SAMPLES

OCTOBER 1968 SURVEY - 8-DAY DAILY DISCRETE SAMPLES 1/

TOTAL COLIFORMS - MPN/100 ml

Missouri River			Geometric Means			
Station Name	River Mileage	Upper Value of 80% Confidence Interval	Coliforms Measured In River During Oct. Survey 2/	Lower Value of 80% Confidence Interval	Predicted Coliform Conc. With Secondary Treatment	Predicted Coliform Conc. With Secondary Treatment and Chlorination
G.P.	811.0	-----	250 3/	-----	250	250
M-52	736.0	6,709	1,380	183	1,380	1,380
M-50	730.0	5,960	2,400	932	2,400	1,900
M-48	717.4	219,000	62,800	16,700	8,270	1,790
M-47	699.5	193,000	57,100	15,700	7,760	1,700
M-46	676.5	174,000	53,000	15,000	7,070	1,550
M-44	654.6	89,000	39,500	16,300	6,560	1,440
M-42	626.2	189,000	52,300	13,500	6,750	2,120
M-41	618.3	219,000	46,600	9,300	6,560	2,050
M-39	610.5	688,000	256,000	88,200	24,700	8,250
M-38	601.3	410,000	165,000	61,600	24,100	8,060
M-36	591.3	358,000	174,000	40,700	23,200	7,760
M-35	580.9	484,000	130,000	32,600	22,400	7,530
M-34	559.7	462,000	167,000	55,800	19,900	6,700
M-33	546.7	366,000	189,000	90,700	19,100	6,430
M-32	525.1	227,000	100,000	41,300	17,700	5,970
M-31	507.5	286,000	134,000	58,000	16,700	5,630
M-30	488.3	599,000	154,000	36,800	15,400	5,210
M-29	469.0	382,000	148,000	53,000	14,400	4,880
M-28	452.3	248,000	57,700	12,500	13,600	4,650

1/ 8-day average is for typical fall weather, where total precipitation was 0.46 inches in Omaha

2/ Values taken from Table A-5 in Water Quality Standards Conference - State of Iowa Report

3/ Average of two grab samples.

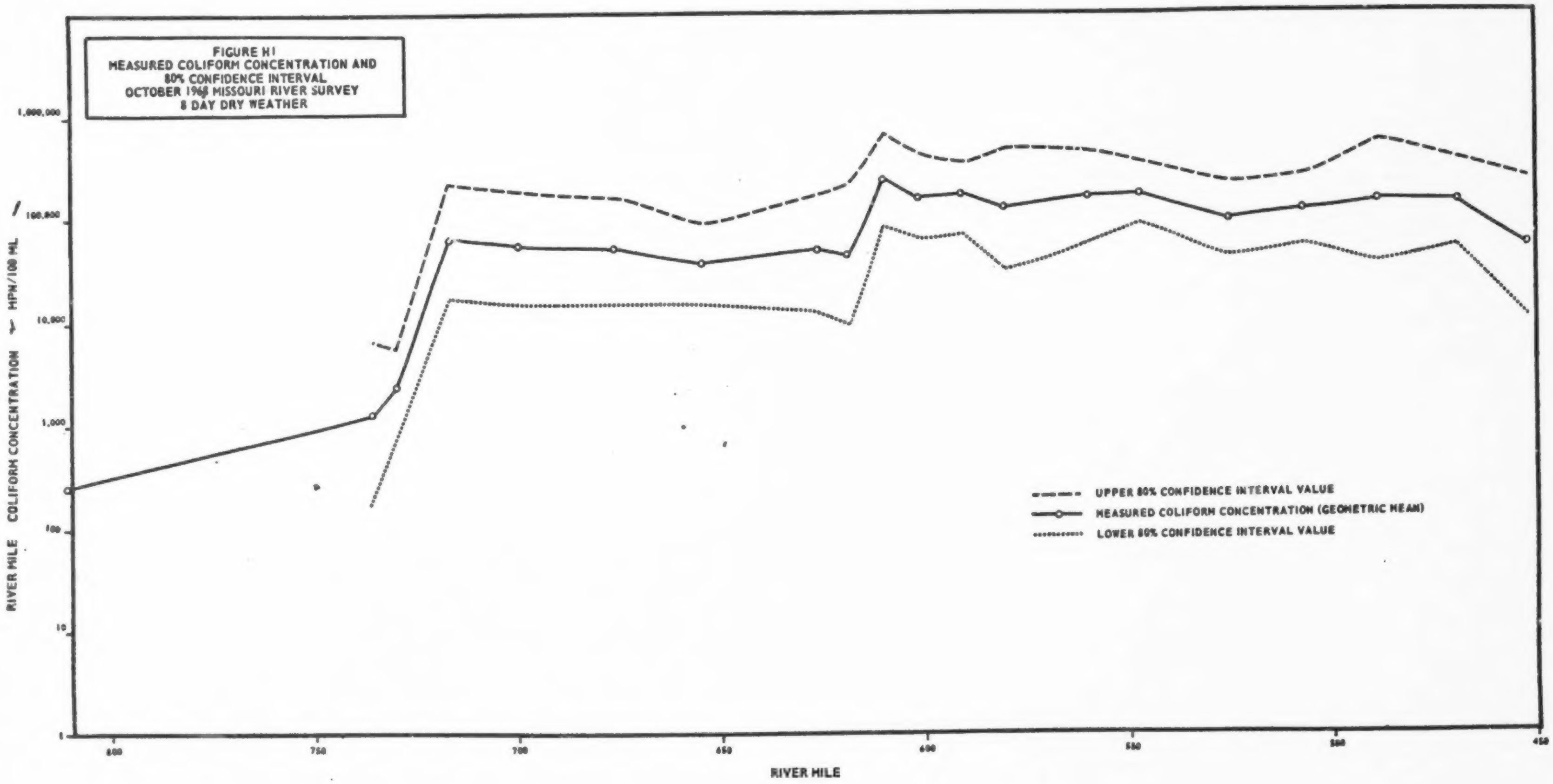


FIGURE H1
MEASURED COLIFORM CONCENTRATION AND 80% CONFIDENCE INTERVAL
OCTOBER 1968 MISSOURI RIVER SURVEY
8 DAY DRY WEATHER

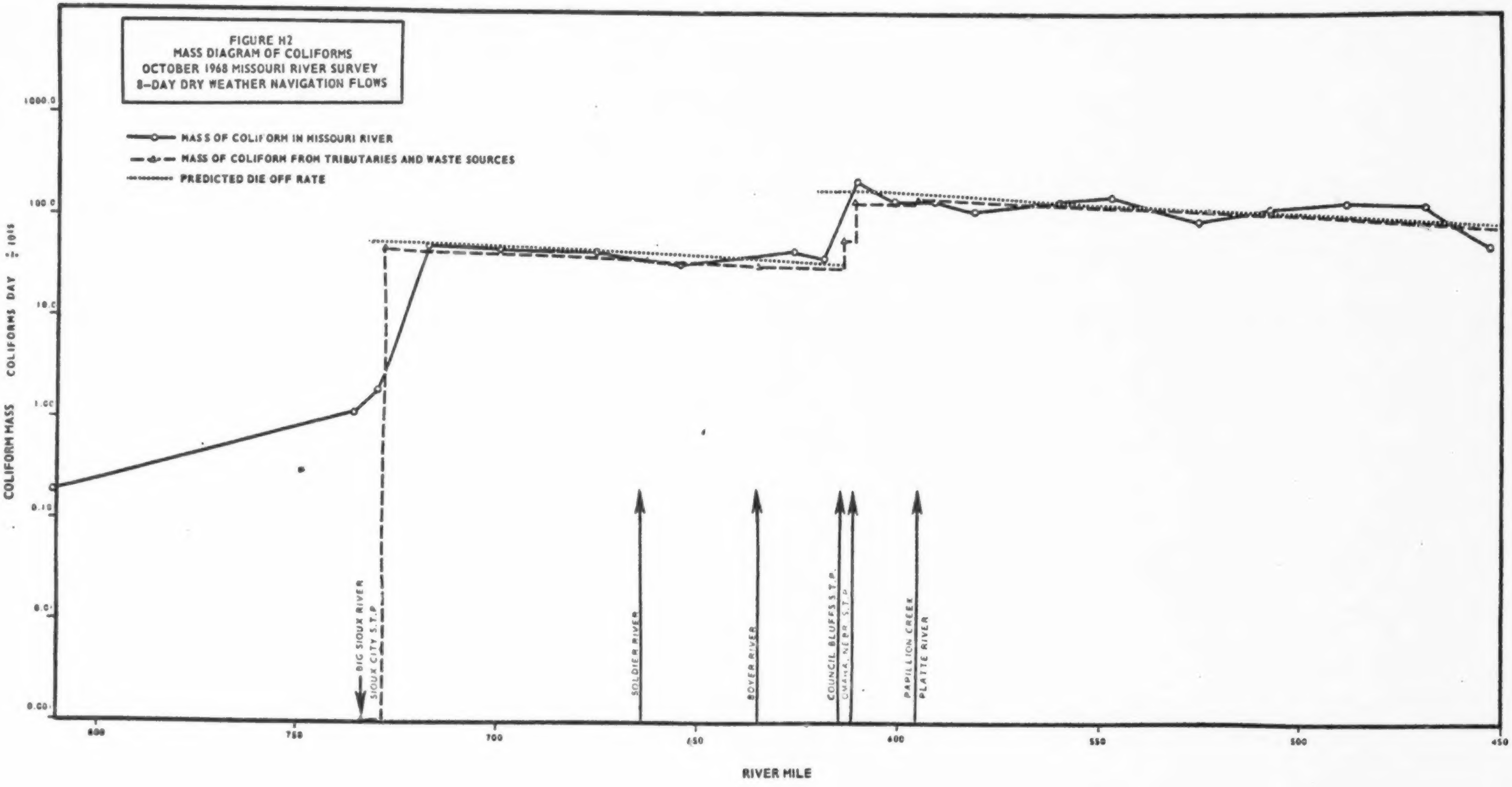


FIGURE H2
MASS DIAGRAM OF COLIFORMS
OCTOBER 1968 MISSOURI RIVER SURVEY
8-DAY DRY WEATHER NAVIGATION FLOWS

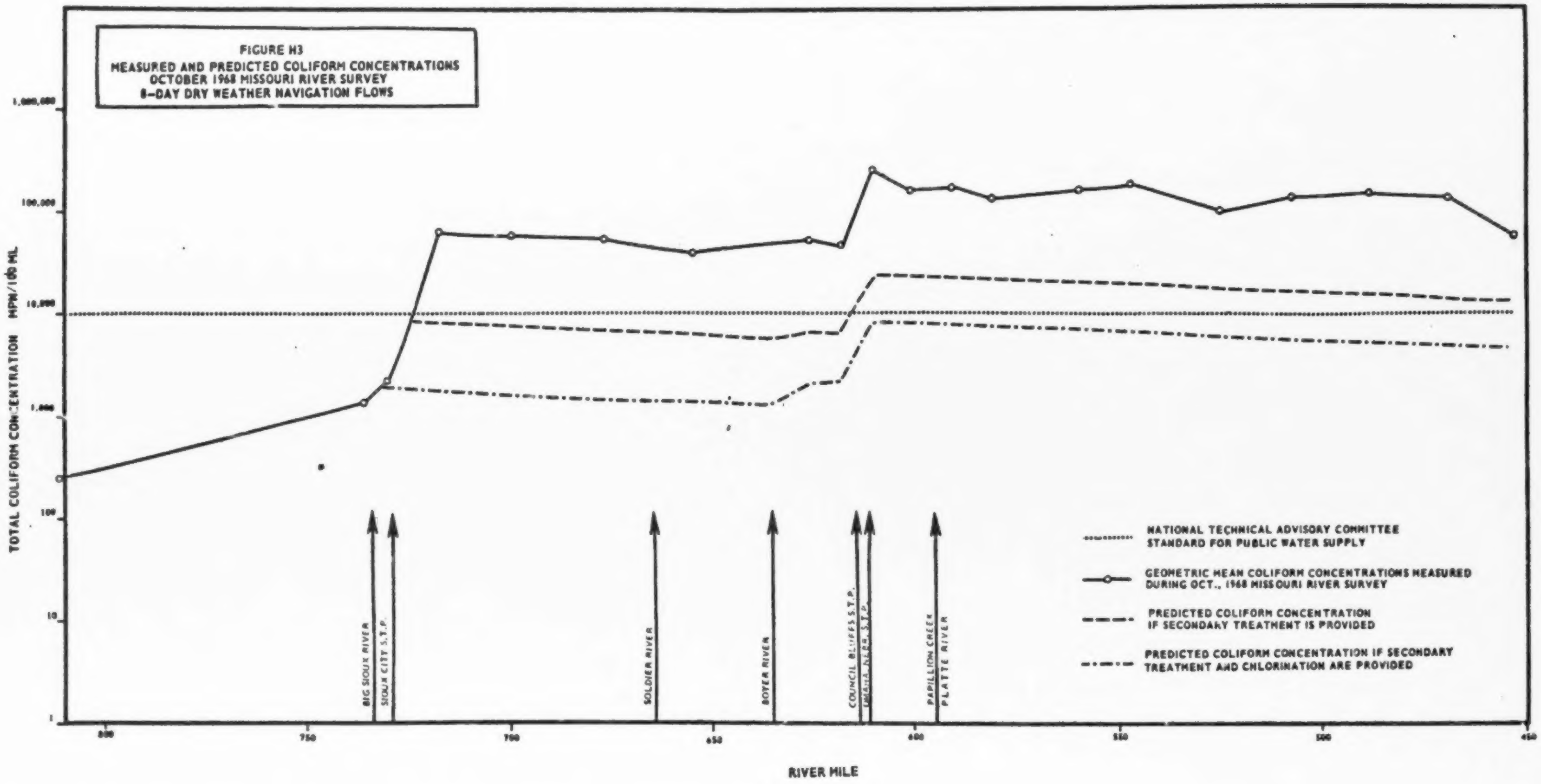


FIGURE H3
MEASURED AND PREDICTED COLIFORM CONCENTRATIONS
OCTOBER 1968 MISSOURI RIVER SURVEY
8-DAY DRY WEATHER NAVIGATION FLOWS

C. V. Blomgren

MR. BLOMGREN: This conference was called by notice of March 5, 1969, by the Secretary of the Interior. The purpose of the conference is to resolve those excepted portions of the Iowa Water Quality Standards. The main exceptions are as follows: (1) The establishment of treatment requirements and an implementation plan for waste discharges to the Missouri and Mississippi Rivers; (2) The specification of requirements for disinfection of controllable discharges which may be sources of bacteriological pollution; and (3) The development of water temperature criteria for the interstate waters of the State other than the Missouri and Mississippi Rivers. The questions on phenols, radioactivity and nondegradation were adequately discussed in the Davenport session on April 8 and 9, 1969.

This session of the conference is specifically aimed at those interstate waters draining into the Missouri River and the main stem of the Missouri itself. We have demonstrated in our report just reasons for the exceptions taken by the Secretary of the Interior. Clean water is no longer a free resource in unlimited quantities that is readily available at our doorstep. The Water

Quality Act of 1965 was based on public recognition of this fact and clean water is the primary reason we are here today.

The Federal Water Pollution Control Administration is dedicated to the cooperation with the States in protecting and enhancing the water quality for the present and future generations.

In summarizing our report, I want to dwell on three major topics. These are: (1) The recognized water uses; (2) The present water quality and waste disposal practices; and (3) The damages to or impairment of both present and future uses due to the water quality degradation.

The State of Iowa has identified in its water quality standards only two beneficial uses for the Missouri River. These uses are public water supply source for Council Bluffs and support of aquatic life for the full length of the river. The Department of the Interior believes that from Sioux City to the Iowa-Missouri border there are at least six principal categories of water use. Our personnel have made water quality studies and on-site surveys.

C. V. Blomgren

The primary use is public water supply. The Missouri River is the water supply source for over 3,000,000 people in 11 separate communities in the reach between Sioux City and St. Louis. Council Bluffs, Omaha and St. Joseph alone use over 62 million gallons of water per day for municipal water supply.

Recreation on the Missouri is a reality. Figures compiled from Iowa's outdoor recreation plan indicate that 52 million days of recreation use occurred in the western region of Iowa in 1965. In Iowa alone, our survey personnel identified 27 public access sites for the Missouri River. Iowa has over 75,000 power boats registered, many of which are used on the Missouri. There are numerous private recreational developments on the river bank. The potential for further water-based recreation is emphasized by the statement presented by Mr. Glen Powers, Planning Director of the Iowa State Conservation Commission, in which he stated, and I quote: "The Missouri, on our western boundary, probably has the greatest potential for recreational development of any one area that we could mention."

Perhaps the best way to depict the recreation potential of the Missouri River is to outline the more significant actions proposed and express some of the pertinent extracts from the reference material. Foremost is the establishment of the Lewis and Clark Trail along the full route of the Missouri River. Since Congress established the Lewis and Clark Trail Commission in 1964, the Missouri River has been recognized as a national resource worthy of development to a far greater degree than heretofore. The purpose of this act was to create an appreciation of the resources, encourage their conservation, and to promote the protection and development of outdoor recreation resources along the route for public use and enjoyment. The development plan prepared by the Bureau of Outdoor Recreation provides for many and varied resources linked along the entire route to satisfy the full spectrum of recreation activities from the most active to the most passive. Some 35 recreation sites were identified for construction by the Corps of Engineers between Sioux City and Rulo, Nebraska.

The National Commission, in association with all of the affected States including the Iowa State Lewis and Clark Trail Committee, is now implementing those actions necessary to achieve the national objectives. To date, one of the principal tasks has been accomplished--that is, the marking and historical interpretation of the route on the roads which parallel, adjoin, and otherwise provide access to the river. Among the problems mentioned as confronting full attainment of the recognized goals is water pollution. The Commission specifically recommended that the FWPCA give continuing attention to the abatement and control of water pollution and that States also take steps to strengthen measures to reduce water pollution along the Trail route.

Commercial fishing is another category of use which we recognize on the river. In the State of Iowa alone 17 commercial fishing activities were identified by interview.

The Missouri River is an integral part of the Mississippi flyway for migrating waterfowl. As such, it affords an intermediate resting and feeding area for the waterfowl. It is important to protect the water quality to sustain the food supply and resting areas. In addition, the area caters to thousands of duck and goose hunters each year with the associated esthetic and economic benefits. Eleven refuge or hunting sites were identified. We believe that many more exist.

The river is used as a source of industrial water supply, primarily cooling water, by two separate power generation facilities in Iowa.

The navigation activities carry considerable tonnage of agricultural and industrial materials. These materials are transhipped each year from the five commercial docking and loading facilities located in Iowa. Personnel on these craft are subject to contact with potential disease producing agents found in the river.

We have shown in our report specific documentation to support the six categories of use that must be recognized. This expanded scope of uses, when compared to the two recognized in Iowa's water quality standards, serves to emphasize the necessity for resolving the exceptions taken by the Secretary of the Interior. The purpose and intent of these standards are to protect and enhance quality for all beneficial uses.

Having documented the uses, I now want to summarize the cause-effect aspects of existing water quality and waste disposal practices. The data contained in the report to support this analysis are from baseline surveys of the Missouri River conducted in October 1968 and January 1969; the Construction Grants Program; and from our three surveillance stations located at Yankton, South Dakota, Omaha, Nebraska, and St. Joseph, Missouri.

In the Iowa portion of the Missouri drainage basin, there are a total of 146 municipal waste treatment facilities. One hundred eighteen of these plants are located on intrastate waters, twenty-six are on interstate waters, and two discharge directly into the Missouri River. In addition, there are 12 industrial or other separate waste sources in the Iowa drainage area. To complete the waste source inventory, the 12 municipal waste discharges and 1 industrial source located on the main stem of the Missouri River in Nebraska and South Dakota are cited in our report. These States are committed to secondary treatment.

A further breakdown of the municipal waste inventory shows that of the 146 plants discharging to interstate and intrastate streams in Iowa, 112 provide secondary treatment, 23 primary treatment, and 11 have no treatment. The results of our survey shows the primary plant at Sioux City discharges wastes equivalent to a population of 250,000,while there are only 120,000 residents. Council Bluffs shows the same picture. The population equivalent of their waste discharges after primary treatment is 134,000, while the population is only 60,000. The load from Council Bluffs will increase significantly with the addition of the new packing plant.

The impact of these waste sources on the quality of the Missouri is clearly demonstrated by the data contained in Appendix A, B, and F of our report. The majority of these data were collected during our baseline survey of the Missouri River between Gavins Point Dam and St. Joseph, Missouri.

Three different hydrologic conditions were encountered during this survey. The first was the dry weather normal autumn navigation flows, the second was wet weather autumn flows as influenced by rainfall runoff, and the third the winter flow conditions with extensive ice coverage. In general, the results of the surveys demonstrated increasing water quality degradation progressing in the downstream direction.

Starting at Gavins Point Dam, the data

demonstrate a relatively high quality water suitable for all beneficial uses. Indices of pollution such as suspended solids, nutrients, dissolved organics and bacterial indicator organisms are present in extremely low concentrations. The biological habitat reflects essentially nonpolluted conditions.

Downstream from the Sioux City area, the effects of waste discharges are immediately reflected by the water quality changes. Densities of bacterial indicator organisms increase significantly. Increased concentrations of quality parameters indicative of recent pollution such as nutrients (nitrogen and phosphorus) and dissolved organics are found. There is also serious destruction of the aquatic habitat in the Sioux City area. We know of no other factor affecting water quality that is not man instigated.

Below the Omaha-Council Bluffs metropolitan area, the river quality again reflects the impact of waste discharges. The aquatic habitat for a distance of 54 miles downstream indicated a zone of water quality degradation. Large numbers of the same pollution tolerant organisms were observed in contrast to the clean water forms. Densities of bacterial indicator organisms increase sharply. The concentrations of dissolved organics as measured by BOD and the nutrient concentrations are significantly higher.

During the periods of high rainfall runoff, the quality problems are heightened. The suspended load carried by the river is increased by a factor of 20. The bacterial indicator organisms and nutrient concentrations are more than doubled. This indicates a need for extending pollution control practices beyond the sewer and treatment plant systems.

I have briefly summarized the waste sources and the resulting water quality. Now consider the impact of quality degradation on water uses.

First, let us examine the public water supply use. Large metropolitan areas are using millions of gallons per day for human consumption. In sport or industrial contact with raw water, effort must be made to eliminate the possibilities of contact or ingestion of pathogenic organisms. The Missouri River carries as many as 1,100 fecal coliform organisms per drop, as shown by our data. During the normal fall navigation flows, which are similar to summer flows, we have demonstrated that municipal waste effluents are responsible for over 85 percent of the total coliform bacteria contained in the river. These can be controlled at the source.

The presence of grease balls and other noxious materials cause problems with physical operation of water treatment facilities.

High ammonia concentrations in the water prior to treatment add considerably to the cost of water treatment by increasing the chlorine demand. Effluents from agricultural products companies, if untreated, can greatly increase the amount of ammonia in the water, the need for higher amounts of chlorine and an increase in the cost of water.

Another consideration is the nitrogen and phosphorus in the river. These materials are necessary to support the aquatic biota. If they are present in excess and other conditions are proper, they can stimulate growths of aquatic organisms which may be toxic, cause taste and odor problems and greatly increase the operational costs of water treatment facilities.

The impact of quality on recreational uses involves three separate considerations, one for esthetics and one for water contact situations, and one for physical damage. Recreational use involves esthetic appreciation of the environment, possible contact with the water through wading, swimming or skiing, and hunting or fishing. Poor water quality in the Missouri has resulted in such things as slime and grease on the lines of sports fishermen, the hazard of contact with disease producing agents by boat operators, fishermen, water skiers, and swimmers. The fouling of the river bottom with sludge deposits and the grease and oil rings on the boat hulls and shore appurtenances are evidence of inadequate treatment.

Primary treatment will remove only the larger lumps. Floating grease can be removed by skimming, but the emulsified forms, which are too often the case, pass through the plant readily. The dissolved fractions, the finely suspended materials, and organics of an ever-increasing variation and sophistication are still present and still persist in the effluent from the primary plants. Sioux City and Council Bluffs are prime examples.

But even more important, billions of fecal bacteria are discharged in every gallon of waste processed. These residuals, the bacteria, the suspended solids and dissolved fractions, singly and in combination, impair the full and safe use of the water for recreation today and will restrict optimum development for the future. The Lewis and Clark Trail Development for the Missouri River could ill afford to advertise the wonders of that stream having the knowledge of its quality hazards to the millions of people expected to enjoy it.

Recreation usage is here today and expected to increase tomorrow. Sioux City is proud of its annual aquacade. The numerous marinas, park developments, and recreation sites give promise of more extensive use, providing the water quality can support such activity.

If you were to make a boat trip on the Missouri River, you would have the same experience as our investigators. Putting in at Sioux City, they waded in the water to get into the boat and received splashes in their faces, each drop containing 14 bacteria of fecal origin. As they progressed downstream, the fecal bacteria become more numerous ,reaching as high as 1100 per drop. Grease balls the size of oranges bounced off their craft.

Animal parts were seen in the stream. Human refuse of all types were apparent. Pleasure boating certainly is affected by these conditions.

The quality degradation has impact on the other recognized uses, too. Commercial fishermen, Phil Randall and Roy Auckenback, have found nets clogged with grease and sewage solids along with a declining catch. Customers who find the fish flesh tainted and unpalatable want their money back. For fishermen and others who work on the River the potential contact with disease-producing agents is ever present. This water use needs protecting, too.

Severe degradation of stretches of the river was indicated by the changes in populations of the river bottom dwelling organisms. This affects the food chain for some types of fish and further reflects the need to protect the aquatic habitat.

We have detailed in our report the impact of quality on the other uses and shown quality criteria necessary to support these uses. These all lead us to the conclusion that we must begin now to protect and enhance the quality to support these uses.

The State of Iowa has exhibited concern for the protection of the quality of the interior interstate streams through waste treatment requirements. In the approved sections of the Water Quality Standards, the State has shown an implementation plan to achieve secondary treatment by July 1, 1972. However, this does not apply to the Missouri River. Pollution from the primary plants is not masked by dilution. The preservation of the river front environment for the citizens of Iowa and for the Lewis and Clark Trail will result in benefits that extend well beyond the boundaries of the State.

Mr. Chairman, at this time I would like to introduce some of the technical people who will elaborate on our summary statement and bring out necessary points concerning the establishment of water quality standards.

The first of these that I would like to introduce is Mr. Ed Geldreich, microbiologist, Public Health Service, Bureau of Water Hygiene, Cincinnati, Ohio, who will discuss the bacteriological criteria and the need for protection of uses through the control of bacterial discharges.

MR. STEIN: While Mr. Geldreich comes up, let's go off the record a minute.

(Off the record.)

MR. STEIN: Mr. Geldreich.

STATEMENT BY E. E. GELDREICH
RESEARCH MICROBIOLOGIST
BUREAU OF WATER HYGIENE, U. S. PUBLIC HEALTH SERVICE, CINCINNATI, OHIO

MR. GELDREICH: Mr. Chairman, ladies and gentlemen.

My name is Edwin E. Geldreich, Research Microbiologist, Bureau of Water Hygiene, Public Health Service, located in Cincinnati, Ohio.

At this time I would like to discuss some of the magnitude of our concern with pathogens in recreational waters.

Our concern about fecal contamination should not be limited to that portion associated with human pollution alone. Microorganisms pathogenic to man may also be found in the excreta of farm animals, wild animals and animal pets. Apparently Salmonella are frequently found in clinically healthy farm animals. Studies on large groups of cattle indicate the percentage of such latent infections is about 13 percent in the United States and about 14 percent in the Netherlands. (Rothenbacker, J. H., Am. Vet. Med. Assoc. 147:1211-1214, 1965.) Between 3.7 to 15 percent of clinically healthy sheep have been reported to also be carriers. With respect to pigs, the percentage of symptomless carriers has been reported to range from 15 to 20 percent in the Netherlands; 7 percent in France; 12 percent in England; 13.4 percent in Norway and 22 percent in Belgium. (Prost, E. and Riemann, H. Food-Borne Salmonellosis; Ann. Rev. Microbiol. 21; 495-528, 1967.)

The Salmonella strains most frequently isolated from both diseased and healthy farm animals include the following 13 serotypes: S. typhimurium, S. derby, S. dublin, S. oranienburg, S. java, S. choleraesuis, S. anatum, S. newington, S. infantis, S. stanley, S. abony, S. chester, and S. meleagridis.

References:

Nottingham, P.M. and Wiselmann, A. J., Salmonella infection in calves and other animals. New

Zealand J. Agri. Res. 4: 449-460 (1961).

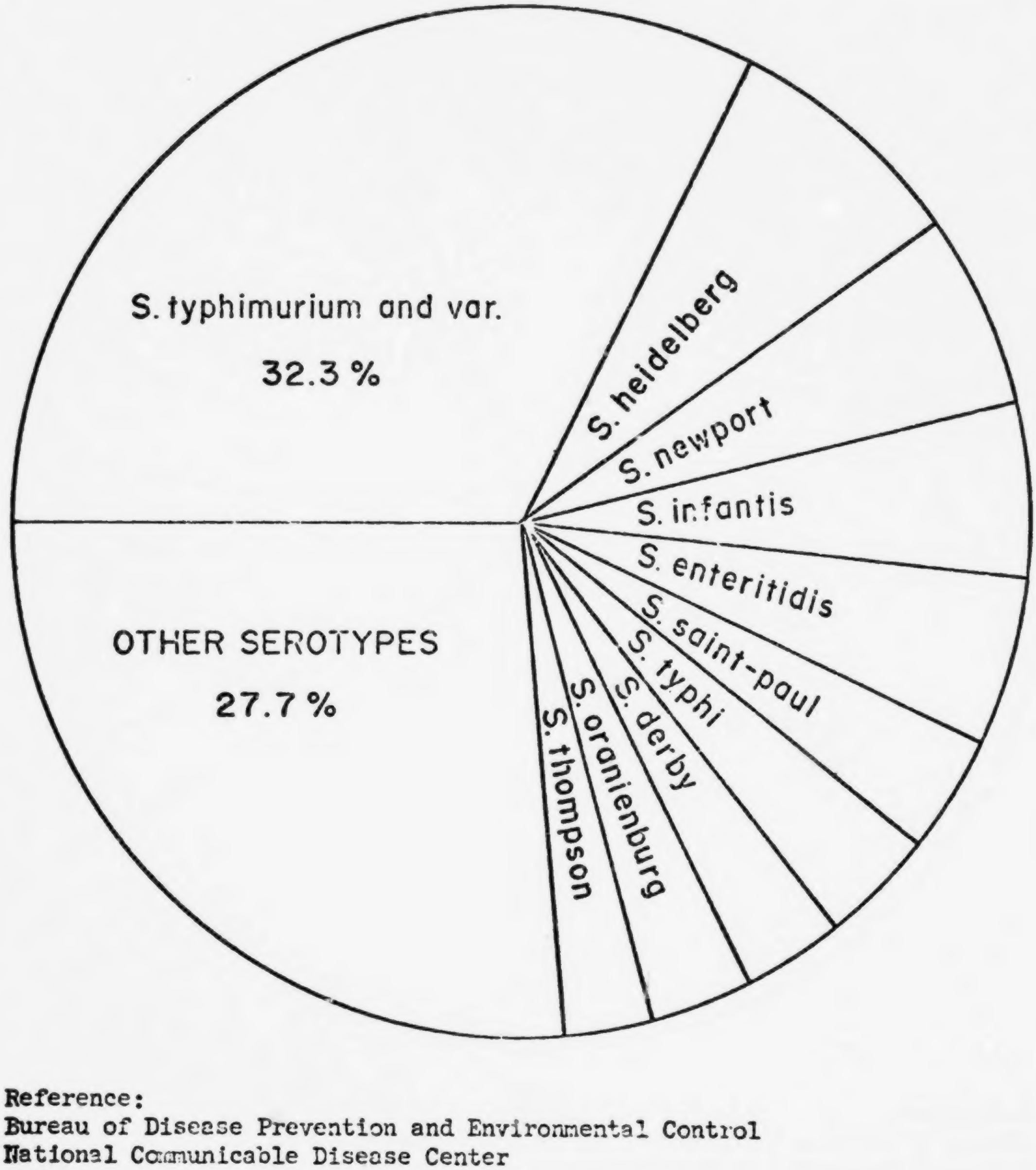
Pollach, W., Investigations on Salmonella in Slaughterhouse Waste Waters in Vienna. Wien. Tierarztl. Mschr. (Germany) 51: 161-164 (1964).

Miner, J. R., Fina, L. R., and Piatt, C., Salmonella infantis in cattle feedlot runoff. Appl. Microbiol. 15: 627-628 (1967).

Peterson, K. J. and Coon, R. E., Salmonella typhimurium Infection in Dairy Cows. Jour. Amer. Vet. Med. Assoc. 151: 344-350 (1967).

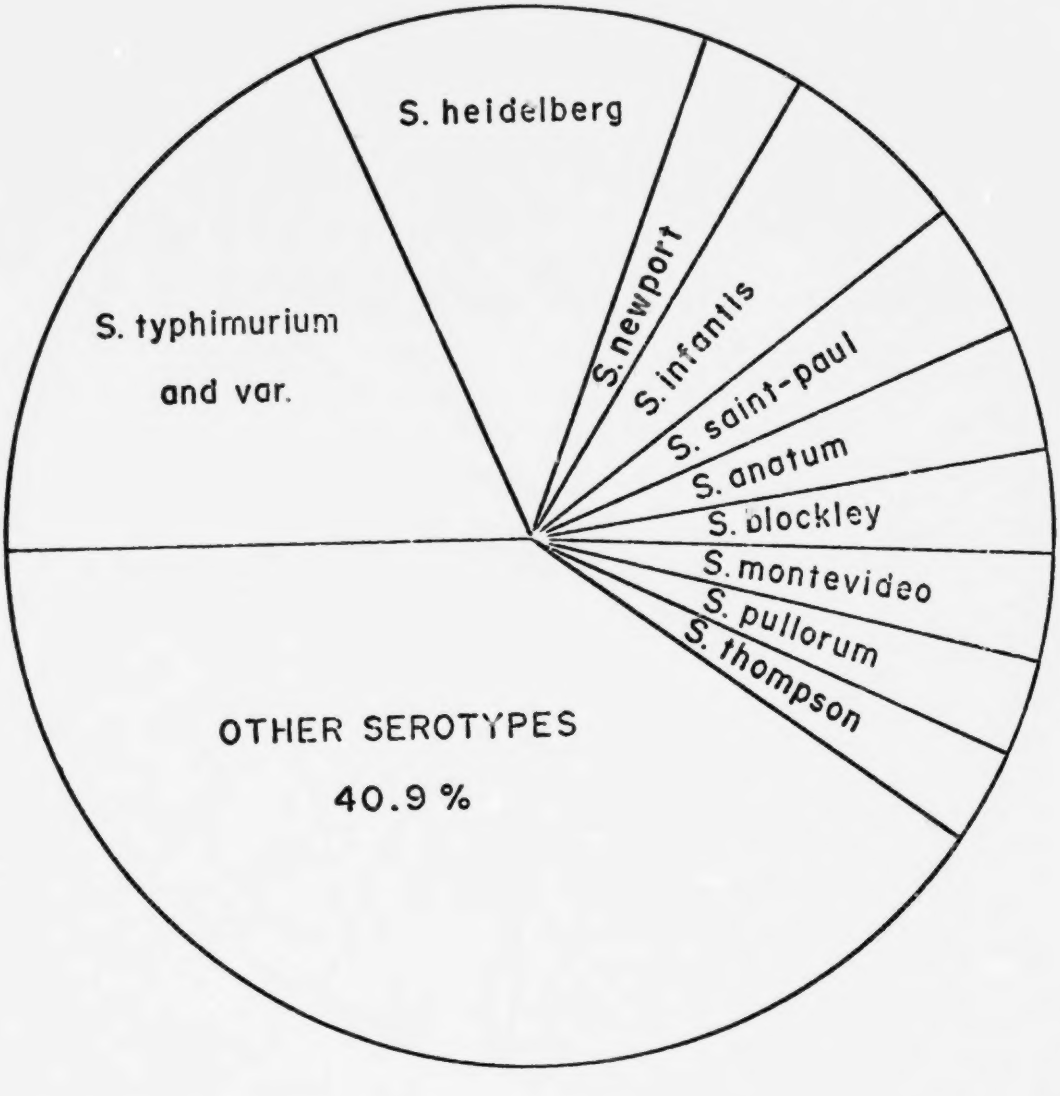
In man, typhoid salmonellosis is specific, that is, it does not occur in farm animals. This disease is produced by S. typhi and the paratyphi strains A, B and C. However, Salmonella species frequently found in farm animals do cause gastrointestinal disturbances in man and have been observed to be the infective organism in a number of epidemics. Of the 13 Salmonellae serotypes reported above to be frequently found in farm animals, 4 of these serotypes were among the 10 most common Salmonella listed in 1965 by the National Communicable Disease Center to be isolated from humans in the United States (Figure 1). In recent years, a number of epidemics have been observed in the human population which were caused by 6 of these 13 Salmonella strains frequently found in farm animals.

ISOLATIONS OF SALMONELLAE SEROTYPES FROM HUMANS IN THE UNITED STATES IN 1965



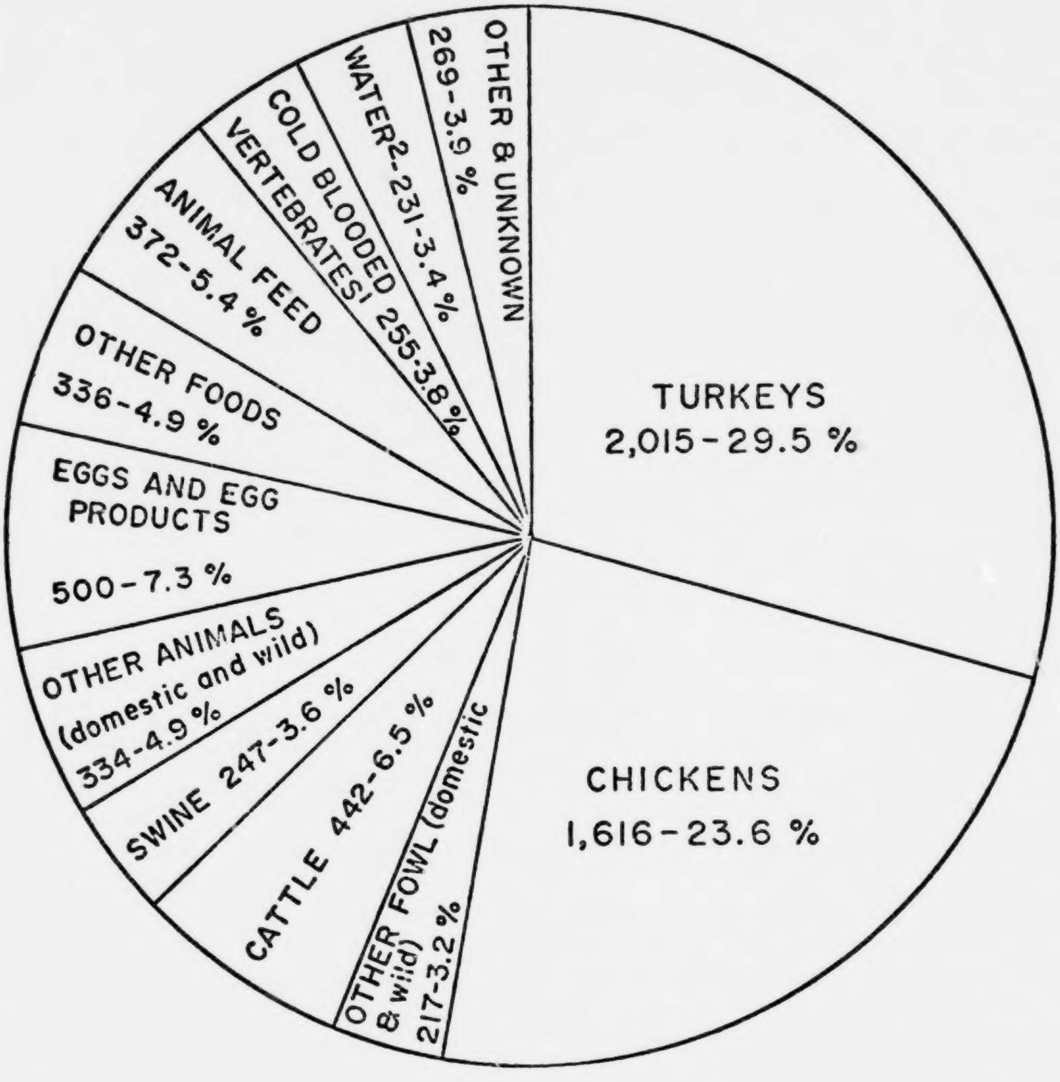
Reference:
Bureau of Disease Prevention and Environmental Control
National Communicable Disease Center
Atlanta, Georgia 30333

ISOLATIONS OF SALMONELLAE SEROTYPES FROM NON-HUMAN SOURCES IN THE UNITED STATES IN 1965



Reference:
Bureau of Disease Prevention and Environmental Control
National Communicable Disease Center
Atlanta, Georgia 30333

NUMBER AND PERCENT OF NON-HUMAN SALMONELLA ISOLATIONS FROM THE INDICATED SOURCES IN THE UNITED STATES



1965

Reference:
Bureau of Disease Prevention and Environmental Control
National Communicable Disease Center
Atlanta, Georgia 30333

Recreational waters in Iowa have been reported on occasion to be contaminated with pathogenic leptospires which gain access to the blood stream through skin abrasions or mucus membranes to produce severe infections involving the kidneys, liver, and the central nervous system. The organism enters the bathing waters from the direct urination of infected cattle, swine, and wild animals that had access to the stream or from drainage of adjacent livestock pastureland. Although transmission of leptospires from infected reservoir hosts does occur throughout the year, epidemics in the United States have occurred almost exclusively during the summer months.

Pathogenic leptospires have been isolated on occasions in the following Iowa streams: Shellbrock River, Winnebago River, Mississippi River, Iowa River, and the Cedar River. They have also been isolated from streams in the States of Washington and Pennsylvania, which were frequented by infected cattle.

Waterborne epidemics due to pathogenic leptospires do occur. One outbreak of leptospirosis was reported from Philadelphia in 1941 in which seven persons contracted the disease by bathing in polluted water.

Leptospires were isolated in the urine of two persons and five cattle who had access to the same stream and had been used for swimming by these two individuals.

In another study, 50 cases of leptospirosis were reported from persons who had become ill after swimming in a slow-moving stream alongside a field where cattle and swine were pastured. This pathogen has also been the cause of various epidemics involving groups of persons who swam in farm ponds and streams in California, from polluted canals in Europe, especially in Holland where the pathogenic leptospires were the source of waterborne outbreaks chiefly among the bathers in these canals.

Survival of leptospires in the water environment depend upon the same numerous factors that have been established for bacterial indicator systems and for Salmonella. However, because of the more difficult culturing procedures now available for leptospires, many of the interrelated influences in the water environment are only partially evaluated. Survival in natural waters at five to six degrees Centigrade has been reported to be eight to nine days and five to six days at twenty-five to twenty-seven degrees Centigrade. Leptospires were reported in another study on the survival which indicated that in lake water with low salinity survival time was more than ten days. In lake and river water with a salinity of from 70 to 6,350 parts per million as chloride, leptospires survived for less than a week. During the summer months in the East Indies pathogenic leptospires were noted to survive in water for at least 22 days without apparent loss of virulence. Finally, in culture infected soil, leptospires survived for 43 days and in urine infected soils for 15 days. Simulated studies using stormwater runoff with the addition of rain water to dosed soil indicated the recovery in the water at intervals ranged up to 24 days after that soil had been flooded.

Other pathogens have been found in fecal pollution from farm animals, including Shigella, bovine tubercle bacillus and the round worm ascuris lumbricoides which is pathogenic to man and hog. These studies on pathogenic organisms illustrate and add support to our concern about fecal pollution from all warm-blooded animals, not just from man alone.

Let me now briefly talk to you a little bit about pathogen occurrence in raw sewage and sewage treatment effluents.

Pathogenic organisms occur in polluted streams and lakes as a result of contamination by fecal discharges from warm-blooded animals. The access of fecal pollution to water may add a variety of intestinal pathogens at any time, and at one time or another enteric pathogenic bacteria will be present. The most common genera of pathogenic bacteria found in water are: *Salmonella*, *Shigella,* enteropathogenic *Escherichia coli*, *Leptospira* and *Mycobacterium*.

There is sufficient evidence from the literature to indicate pathogenic organisms can be present in the excreta of poultry, livestock, cats, dogs, wild animals. Such microorganisms, which are equally pathogenic to man and other animals, may be acquired from contaminated food or water. Even fresh water fish may become actively infected with human pathogens after exposure to contaminated water and carry these organisms to clean stream recreational areas somewhat removed in time and distance.

Pathogenic Conveyance to the Stream

Raw Sewage

Municipal sewage contains the major domestic input of human fecal discharges plus other domestic additions of laundry wastes and food refuse. In some cities, wastes from meat packing and dairy plant operations may also be mixed in the domestic sewage collections

Salmonella and Shigella have frequently been detected in sewage. Raw wastes from institutions treating tuberculosis patients will almost always contain large numbers of tubercle bacilli. Sewage from four sanitoria showed from 425 to 10,000 tubercle bacilli per ml. Municipal sewage containing wastes from dairies and slaughterhouses may also be expected to discharge M. tuberculosis in their wastes.

Enteric viruses which are capable of producing diseases in humans are excreted by infected individuals into domestic sewage in large quantities. These viruses include those of the enterovirus group (polioviruses, coxsackieviruses A and B, and echoviruses) the adenoviruses, reoviruses, and the infectious hepatitis virus. The peak incidence of isolation of enteric viruses in sewage occurs during the warmer months of the year and during periods of epidemic with fluctuations in the predominant type being related to what is prevalent in the community at a given time. Kelly and Sanderson found 15 strains of Coxsackie, ECHO and polioviruses present in raw sewage. Of 150 viruses isolated by Bloom. et al., from sewage samples, 31 were identified as ECHO viruses, 4 as polioviruses and 75 as coxsackie. Many septic tank effluents have been found to contain enteroviruses. In one instance, septic tank effluent still contained viable poliovirus six months after a child from that home had contracted poliomyelities.

Trickling Filter Effluent

Sewage treatment by the trickling filter process has been found to reduce Salmonella schottmulleri densities from 84 to 99 percent, tubercle bacilli (Mycobacterium tuberculosis) populations by 66 percent, enteric viruses in a range from 40 to 60 percent, tapeworm ova by values ranging from 18 to 70 percent, and cysts of Endamoeba histolytica by 88 to 99 percent. Total coliform reductions were reported in various investigations to range from 82 to 97 percent.

Activated Sludge Systems

In activated sludge systems, coliform

organisms, Salmonellae, Shigellae, and M. tuberculosis, were reduced in amounts ranging from 88 to 99 percent, poliovirus, type I, by 90 percent, and coxsackie A9 virus by 98 percent.

Anaerobic Digestion

Removal of S. typhosa in anaerobic digestion was reported to range from 25 to 92.4 percent depending upon retention time. M. tuberculosis reduction after anaerobic digestion was reported to be 69 or 90 percent, depending upon whose work you are citing. Although this sewage treatment method was quite effective in reducing cysts of E. histolytica, Cram found anaerobic digestion comparatively ineffective in the inactivation of parasitic ova.

Waste Stabilization Ponds

The treatment of sewage in waste stabilization ponds will generally produce total coliform reductions ranging from 50 to 99.9 percent. Studies on the fate of Salmonella in stabilization ponds indicate a similar high order of destruction.

Chlorination of Effluents

In a review of the literature on removal of pathogenic microorganisms by trickling filters, activated sludge, anaerobic digestion and stabilization ponds, Kabler concluded that these treatment processes will markedly reduce the number of pathogenic organisms present. However, the resulting effluents will contain a portion of each kind of microorganism originally present in the raw sewage. Those pathogenic bacteria, virus and parasites that do remain in the treated effluents constitute potential health hazards to persons using the receiving waters for recreational purposes. Where these waters are used as a source of raw water supply, any accidental break in treatment could quickly bring pathogens to our public water supply systems. Application of appropriate chlorination procedures to effluents from secondary treatment of sewage will further reduce the pathogenic bacterial populations to below demonstrable densities.

Many factors are involved in sewage chlorination, including organic residuals, effluent pH and temperature, chlorine contact time, uniformity of effluent-disinfectant mixing, among others. Primary sewage effluents are more difficult to chlorinate to a specific coliform content than are secondary effluents. Chlorination of primary effluents should not, under any circumstances, be considered a substitute for secondary treatment. The primary measurement for the adequacy of chlorine disinfection of treated sewage must be based on the coliform count since methods for pathogens remain too complicated for routine monitoring. Finally, additional advanced waste treatment by chemical flocculation with sedimentation may be necessary in special problems involving re-use water for complete removal of parasitic ova and virus.

Finally a brief statement here about the bacterial survivals in streams.

Survival of bacterial indicators and any pathogens present in a pollutional discharge to the receiving stream are going to be influenced by many interrelated environmental factors. These factors include: available nutrients, water temperature, water pH. turbidity and sedimentation, chemical constituents of the receiving stream, chemical pollutants discharged, antagonistic action of associated bacterial species and phage types and exposure to the ultraviolet action of sunlight.

E. E. Geldreich

Research studies on bacterial survival in streams indicate that bacterial nutrients in terms of a nitrogen source and a carbon source and winter stream temperature plus a source of fecal pollution can extend the survival of this hazardous pollution many miles downstream. With summer stream temperatures and bacterial nutrients, some multiplication of pathogens is possible. In either case, the public health hazard has increased. This deterioration in water quality should not be tolerated from a public health viewpoint, either for recreation water quality or for a raw water source to be processed into a public water supply.

Bacterial nutrients are derived from raw sewage, food processing wastes, and poor quality sewage treatment involving low BOD removal. Practical removal figures for primary treatment range from 40-60 percent BOD removals; secondary treatment 80-90 percent BOD removal; and tertiary treatment 95-98% BOD removal. Thus the natural stream purification rate can be greatly modified by this type of discharge.

Frequently, chlorination of primary effluent is attempted to further reduce the bacterial discharge. This creates another bacterial problem downstream known as aftergrowth. Aftergrowth is a product of many interrelated factors associated with bacteria and their environment. Because disinfection by chlorination rarely is complete, some organisms survive to become the inoculum that utilizes the available nutrients. These organisms include strains which are protected from contact with chlorination by aggregates of suspended matter. As the aggregates disintegrate, viable cells are released into the partially treated primary effluent. Proper environmental conditions for this specialized type of bacterial regrowth occur with water temperature above 15 degrees Centigrade, a source of bacterial nutrients above a critical level, adequate flow time between entry of chlorinated effluent into the receiving stream and some location downstream, plus other interrelated factors associated with the bacterial flora and its water environment. With reference to required flow time downstream, most regrowth problems occur between a one- to two-day flow from the entry of chlorinated effluent. This time is needed to permit organism recovery from chlorination damage and subsequent multiplication of the bacterial population.

With respect to chlorination of effluent from sewage that has received secondary treatment, available research data demonstrates no evidence of aftergrowth even though stream temperature was 22 degrees Centigrade, during a study on a small stream in California. This result reflects the excellent nutrient reduction in the secondary treatment of sewage by this activated sludge process and the effect of blocking a key requirement essential to aftergrowth development.

It has been my observation that most aftergrowth problems occur as a result of either poor sewage treatment for BOD removal or as a result of nutrient waste additions downstream from the chlorinated effluent discharge.

Thank you.

MR. STEIN: Thank you, Mr. Geldreich.

We will now call on General C. Craig Cannon, Missouri River Division Engineer, Corps of Engineers, Omaha.

Gen. Cannon.

STATEMENT BY GENERAL C. CRAIG CANNON
MISSOURI RIVER DIVISION ENGINEER
CORPS OF ENGINEERS, OMAHA, NEBRASKA

GEN. CANNON: Thank you, Mr. Chairman.

I don't know whether any of you are from Sioux City, but the Sioux City Chamber of Commerce has a tradition of each summer having a steak fry on a sand bar in the upper Missouri. Part of that tradition is to invite the Army Division Engineer up there and forcefully throw him into the river. Of course he is expected to put up a fight and take as many with him as possible. After hearing the previous speaker, I can assure Sioux City that I am going to put up more of a fight this year than last year.

(Laughter.)

Ladies and gentlemen, while my division of the Corps of Army Engineers is interested in all the uses of the Missouri River and its tributaries, this morning I will comment primarily on our work below Sioux City. However, we must continue to recognize that the chain of reservoirs extending from Montana across the Dakotas exerts a profound influence upon the flow of the Missouri. In contrast to flood and drought periods of the past, we now have a pattern of discharge much better suited for utilization of the river. In years of normal runoff we are able to control the Missouri to about 35,000 cubic feet per second at Sioux City through the navigation season, and to about 15 to 20 thousand cubic feet per second during the remainder of the year.

Of course in abnormally wet years, such as the present one, or in the unhappy event of a drought year, these manifestations will affect the degree of our control: for example, on recent days we have been limiting the releases from Gavins Point to 6,000 second feet.

Increased upstream uses of water for irrigation, municipal and industrial water supply, agricultural and other purposes will eventually deplete the available water supply so much that minimum releases at Gavins Point Dam may be as low as 3,000 cubic feet per second during the non-navigation season for extended drought periods.

In a 1951 report of the Missouri Basin

Interagency Committee on "Adequacy of Flows in the Missouri River" a minimum release of 3,000 cubic feet per second was stated to be necessary to maintain a dissolved oxygen level of 5 parts per million in the stream. And remember that that was speaking of conditions as they existed in the early 1950's.

Below Sioux City our basic functions are flood control, bank stabilization and navigation. The reservoirs play a major part in these functions, but in addition we have municipal and agricultural levee systems and numerous dikes and revetments. Our work on the river has resulted in more intensive use of the banks for agricultural, residential, commercial and industrial purposes. The Corps has recognized the beneficial effects of reduction in the silt load and in uniformity of flow on water supply and sewage dilution functions of the river. However, the Congress originally considered these effects of the reservoirs as bonus benefits and no monetary value, therefore, was credited to the projects.

Subsequent to 1961 and the amending legislation of Public Law 87-88, the Corps has had the authority to assume a more specific role in water quality control and to utilize resulting benefits as project purposes. In general the Corps' function in regulatory control of water pollution is limited. However, we do have certain responsibilities regarding the discharge of pollutants from floating or fixed installations when the discharges are detrimental to the operation of the project.

The past 20 years have seen a tremendous increase in water-based recreation, boating, swimming fishing, and general shoreline recreation. The Corps has for many years been authorized to provide facilities for recreation at reservoirs in cooperation with local and State agencies. Utilization of these facilities has been phenomenol and continues to increase.

The general improvement of water conditions on the lower Missouri has also resulted in increasing public use of the river. In response to this trend, and in the interest of public safety and convenience, the Corps was authorized by the Flood Control Act of 1962 to extend its recreational development to all water resource projects. The present policy is to cooperate with local interests and the State agencies in the development of boat ramps, parking and picnic areas and similar facilities along the Missouri from Sioux City to the mouth of the river near St. Louis.

Some of these facilities have been built. Others are under construction or scheduled for early construction and many more are planned for the future as the need develops and as the necessary participation by local interests is negotiated and funds become available.

It does not require a sanitary specialist to see that water pollution is inimical to recreational use of a river. I shall leave to those specialists the problem of determining what levels of pollution are tolerable and consistent with intensive recreational use. Esthetic enjoyment of a river environment is adversely affected by obnoxious odors, by floating matter and by suspended or dissolved materials affecting water clarity. Fishing success and the edibility of fish caught are definitely related to water quality.

Again, emphasizing that water quality standards are not a major function of the Corps of Engineers, I can and do state that we as an agency of the Federal Government charged with providing certain recreation factilities are interested in and support the adoption and maintenance of standards which are conducive to and consistent with intensive and increasing public use of the Missouri River. The Corps would certainly dislike seeing a reduction in the recreational utilization of the river and a resulting loss of recreation development due to pollution. It appears that such a reduction might come about as a result of public disinclination to use a polluted river for either esthetic or sanitary reasons or by regulation which would prohibit or limit certain public uses in the interest of health and safety. In either event, non-use of the river for recreational purposes would have an adverse effect upon plans for the construction of facilities intended for increased recreational use.

I realize that my statement does not provide any quantitative basis for pollution standards. That is not my intent or purpose. I hope I have made it clear that the Corps of Engineers supports wholeheartedly those antipollution programs and controls which are conducive to true multi-purpose use of the Missouri River, not only for flood control and navigation but also for general recreational use by the people of our Nation.

Thank you very much.

MR. STEIN: Thank you, Gen. Cannon.

At this point we will take our morning recess for 10 minutes. Please come back.

(RECESS)

MR. STEIN: May we reconvene.

We will continue with the Federal presentation. To give you a notion of what we are going to try to do, we will recess for lunch at 12 o'clock for about an hour and a half, and then we will have, presumably, an afternoon session with, hopefully, one recess, and we will conclude the day's session at 5 o'clock. The way it looks, this will go into tomorrow.

Mr. Blomgren.

MR. BLOMGREN: Mr. Chairman, we have with us Mr. Ted Ferris, Water Hygiene Representative, Environmental Control Administration, Department of Health, Education, and Welfare, Kansas City, Region VI, who will discuss the public health aspects.

STATEMENT OF T. C. FERRIS
WATER HYGIENE REPRESENTATIVE
ENVIRONMENTAL CONTROL ADMINISTRATION
DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE, REGION VI, KANSAS CITY, MISSOURI

MR. FERRIS: Mr. Chairman, ladies and gentlemen.

My name is T. C. Ferris. I am the Water Hygiene Representative of the Environmental Control Administration of the Department of Health, Education, and Welfare, the Region VI office in Kansas City, Missouri.

The Department of Health. Education, and Welfare, acting under the Public Health Service Act has primary Federal responsibility for protecting the health of the people. The Public Health Service has strong interest in the protection and enhancement of community water supplies, both as to adequacy and purity for water reaching the ultimate consumer. Water as it is delivered at the tap should be potable and should meet the recommended Public Health Service drinking water standards.

The discharge of pollutants and wastewaters to rivers constitutes a threat to the health of people living in these watersheds and utilizing these waters for domestic supply, commercial and sports fishing, recreation, and other purposes. The health threat associated with water is of three types: chemical, biological and radiological.

The Public Health Service has long been concerned about the quality of water. The discharge of inadequately treated municipal and industrial wastes can cause impairment of water quality in the interstate rivers covered by this conference. The findings of the conference report indicate that untreated and/or inadequately treated municipal and industrial wastes are being discharged to these waters and that they could endanger the health and welfare of persons, not only in the State of Iowa, but in some of the adjoining States. While the conventional water supply treatment processes are capable of removing or destroying pathogenic organisms, the presence of pathogens in raw water supplies constitutes a hazard potential which is dependent upon human or mechanical failure. Also, polluted discharges constitute a direct hazard to those using the waters for contact recreational purposes.

T. C. Ferris

In 1914, the Public Health Service established and, with periodic revisions, the last in 1962, has maintained and published drinking water standards for water supplies used on interstate carriers and has responsibility for the certification of such water supplies. These standards have been adopted or are used as the guidelines for drinking water quality in nearly all of the States. The Public Health Service has also served as consultant and technical assistant to State and local health departments in their programs for safeguarding the quality of community water supplies.

There are several surface water supplies in Iowa as well as a considerable number of surface water supplies in other States which have their intakes below the waste discharges from municipalities and industries in Iowa. It is also interesting to note that there are more cattle and hogs in the State of Iowa than there are people, and this source of pollution must also be recognized in control measures. The bacterial pollution from cattle and hogs cannot be ignored.

The Iowa surface water quality criteria were submitted to our agency for comments, and on

September 27, 1968, the following letter was transmitted to the Federal Water Pollution Control Administration:

"Under the provisions of the Interdepartmental Agreement of September 2, 1966, we offer for your consideration the following comments on the public health aspects of the Iowa Surface Water Quality Criteria.

"These comments are limited to those criteria considered important to protection of the public health and are primarily concerned with the following subjects: Discussion of Criteria and Surface Water Quality Criteria, relating to Public Water Supply and Recreation.

"Discussion of Criteria

"The discussion of the General Criteria Section notes, 'Treatment less than secondary will not be accepted unless it can be shown that the legitimate uses can be protected with a lesser degree of treatment.' Where legitimate uses of affected waters include public water supply or whole body contact recreation, the Public Health Service does not consider as satisfactory any degree of treatment less than secondary.

"Although no bacteriological criteria have been adopted in the Specific Criteria for the Designated Water Uses Section, the discussion includes definition of bacteriological guidelines for optional application to situations where known controllable sources of coliform bearing wastes are affecting the suitability of a water source for public water supply or recreational use. While the variability of total coliform levels with runoff is recognized, the specification of a sanitary survey backed by a guideline to be used optionally is not considered an adequate criterion. The fact that zoonoses as well as human carried diseases are transmittable to man through fecal matter should be recognized. Adoption of fecal coliform criteria as an acceptable indicator of fecal pollution is appropriate where total coliform concentrations are known to be greatly affected by soil and plant coliform. The Iowa criteria should provide for such criteria as are recommended in Section I of the Public Health Service 'Health Guidelines for Raw Water Quality,' previously submitted to your office for review."

The next section of the letter:

"Surface Water Quality Criteria

"The water quality criteria in the section on Public Water Supply should also be made applicable to waters used in the processing of food.

"Limiting concentrations for the specific constituents arsenic, barium, cadmium, hexavalent chromium, cyanide, fluoride, lead, and phenols are included in the section on Public Water Supply. The concentrations specified for arsenic, cyanide, and phenols exceed those specified by the Public Health Service 'Health Guidelines for Raw Water Quality' and should be changed to conform to the health guidelines. In addition, a number of the chemical constituents specified by the Public Health Service 'Health Guidelines for Raw Water Quality' have been omitted in the specific constituents limited by the Iowa Surface Water Quality Criteria. These constituent limits including those for Radium 226 and Strontium 90 should be included in the Iowa Criteria.

"As has been stated under Discussion of Criteria, fecal coliform criteria for public water supply and recreational uses should be added to the Iowa Criteria. The minimum degree of public water supply treatment necessary to produce potable water from water meeting such criteria should also be stated.

"The opportunity to present this review is appreciated."

That is the end of the letter, quoting.

You will note in this letter that we do not consider any degree of waste treatment less than secondary including disinfection to be adequate where the downstream waters are to be used for public water supply or whole body contact recreation. In our opinion, fecal coliform criteria are appropriate; these criteria should not be modified even on the basis of findings from a sanitary survey. The criteria to be used in Iowa should be no less stringent than the limits placed in our publication, "Health Guidelines for Raw Water Quality." These guidelines provide standards for water to be used for domestic and food processing uses, recreation, shellfish, agriculture, as well as for control measures when considering vectors or the disposal of solid wastes. To cite a few of the standards, we would like to emphasize that the total coliform density shall not exceed 20,000 per 100 milliliters as measured by monthly geometric mean or that the fecal coliform density shall not exceed 4.000 per 100 milliliters as measured by monthly geometric mean for intake water to a water treatment plant providing coagulation, sedimentation, filtration, and disinfection. For water contact recreational uses, the fecal coliform density should not exceed the geometric mean of 200 per 100 milliliters with a sampling frequency of 5 samples per 30-day period taken during peak recreational use. Not more than 10 percent of the samples' fecal coliform densities during any 30-day period should exceed 400 per 100 milliliters.

I am pleased to represent the Department of Health, Education, and Welfare at this meeting. We in the Public Health Service are ready to do whatever we can to cooperate and assist in the job of safeguarding and improving the quality of these waters.

Thank you.

MR. STEIN: Thank you.

MR. BLOMGREN: Mr. Chairman, at this time I would like to introduce Dr. Graham Walton, Chief of Technical Services, Bureau of Water Hygiene, Public Health Service, Cincinnati, Ohio.

MR. STEIN: There is one thing these conferences accomplish: I get to see people I haven't seen for a long time.

STATEMENT BY DR. GRAHAM WALTON
CHIEF, TECHNICAL SERVICES, BUREAU OF
WATER HYGIENE, U. S. PUBLIC HEALTH SERVICE
CINCINNATI, OHIO

DR. WALTON: Thank you, Carl.

I am Graham Walton, Chief, Technical Services, Bureau of Water Hygiene, U. S. Public Health Service, Cincinnati, Ohio.

In the manual "Public Drinking Water Supply Evaluation" now in press, which will replace the 1946 "Manual of Water Sanitation Practice," the Public Health Service recommends permissible bacteriological quality for surface waters receiving "Complete Conventional Treatment" to produce a public water supply. This publication defines "Complete Conventional Treatment" as consisting of chemical coagulation, sedimentation, rapid granular bed filtration, and pre- and post-chlorination. It specifies that the total coliform density of the intake water, as measured by the monthly Geometric

Mean, shall not exceed 20,000 per 100 milliliters unless fecal coliform examinations are made and their density as measured by the monthly Geometric Mean does not exceed 4,000 per 100 milliliters.

The Subcommittee for Public Water Supplies. National Technical Advisory Committee on Water Quality Criteria, in their 1968 report, proposed permissible criteria for intake waters receiving treatment by "the most common processes in use in this country in their simplest form" for production of waters for public use. The defined conventional treatment included chemical coagulation, sedimentation, rapid sand filtration, and chlorination. This subcommittee recognized that many small surface water treatment plants were operated without sophisticated technical control. Starting with these assumptions, this committee recommended that the coliform density, as determined by the monthly arithmetic average of an adequate number of samples, should not exceed 10,000 per 100 milliliters. This limitation, however, may be relaxed provided fecal coliform examinations are made and their monthly average does not exceed 2,000 per 100 milliliters.

Dr. G. Walton

Many State water pollution control agencies have adopted bacteriological standards for surface waters for use in the production of public supplies. Such standards may specify the following:

The monthly average coliform density shall not exceed 5,000 per 100 milliliters nor shall the coliform density exceed 5,000 per 100 milliliters in more than 20 percent, nor shall it exceed 20,000 in more than 5 percent, of all samples examined during each month.

Although we have the technical knowledge, as demonstrated by equipment developed by the"Space Program," to produce drinking water from sewage, it is neither desirable nor economically feasible. Those concerned with the production of "Biologically Safe" public water supplies generally accept the desirability of erecting multiple barriers against waterborne disease-producing organisms. Such barriers include:

1. Effective treatment of sewage and other wastewaters.

2. Natural purification processes which are active in the surface waters receiving the wastes.

3. Water treatment processes, such as

clarification and disinfection.

The Public Health Service recommends that every practical effort should be made to secure intake water from the best available source and to reduce existing and control future pollution of those waters.

The recommended maximum acceptable coliform density, a monthly geometric mean of 20,000 total coliform bacteria per 100 milliliters, or of 4,000 fecal coliform bacteria per 100 milliliters, should not be taken as poetic license to unnecessarily permit maximum acceptable bacterial levels in intake waters to water treatment plants.

In summary, intake water bacteriological standards have been established to permit water treatment plants with rather mediocre facilities and unsophisticated technical control to produce biologically safe water. Moreover, improvement in the bacteriological quality of the intake water frequently results in improvement of other intake water characteristics that may enhance the overall quality of the public water supply.

Thank you.

MR. STEIN: Thank you, Dr. Walton.

May we go on?

We don't often get Dr. Walton, and I say this to the Interior people and anyone else, if you have some questions on water supply, you may find it convenient to take it up with him while he is here.

MR. BLOMGREN: Mr. Chairman, at this time I would like to introduce Dr. Aaron Rosen, Chief, Waste Identification and Analysis Activities, Advanced Waste Treatment Research Laboratory, Federal Water Pollution Control Administration, Cincinnati, Ohio.

STATEMENT BY DR. A. A. ROSEN
CHIEF, WASTE IDENTIFICATION AND ANALYSIS ACTIVITIES, ADVANCED WASTE TREATMENT RESEARCH LABORATORY, FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, CINCINNATI, OHIO

DR. ROSEN: It was suggested I tip this microphone up so I will be talking into it, but I pointed out that for me the microphone doesn't need to be tipped up.

At the meeting last week I made some -

comments on the subject of specific trace organics in water and the relationship to municipal waste treatment. I have now prepared this in the form of a written statement, which I have presented to the recorder, with your permission, Mr. Chairman, and, therefore, at this time I would like to only very briefly summarize the contents of that statement in order to save time, but at the same time to put on record the gist of this point so that subsequent people who may wish to will have the opportunity to refer to it.

MR. STEIN: Without objection, your full statement will appear as if read. There are no substantial departures in that from what you said last week?

DR. ROSEN: No, there are not. It is essentially what I said last week.

MR. STEIN: Right.

DR. ROSEN: The essential point of that statement is that municipal wastes include substances not ordinarily considered as sewage materials. They are chemicals that find their way into the wastes from household uses, such as detergents and disinfectants, from industries and from commercial enterprises. An example of the commercial enterprise would be automobile service stations that dump large quantities of used oil into city sewers.

The question then that comes at issue is what does secondary treatment or its equivalent accomplish in removing these materials and what effect does that have on streams? It is pointed out that many of these chemicals have specific adverse effects. The group at Washington University in St. Louis making studies with specific reference to the Missouri River have pointed out that such trace organics can have effects on humans either consuming or making recreational use of water, on the aquatic organisms in the river, and on industries making use of this water.

Many of these chemicals are readily removed in secondary treatment. Examples would be certain phenols that affect drinking water, certain industrial chemicals that are picked up and accumulated in the tissues of fish and, therefore, make them inedible, among these being things like waste oil material that gives an oily taste to fish. Many of these are removable because they are readily oxidized, others because they combine with the activated sludge flock and are physically removed.

Certain others are not readily oxidized but are reduced markedly. When they are reduced by this kind of treatment, the stretch of river that they would pollute is also then proportionately markedly reduced. Instead of 50 miles downstream affected, perhaps 25 miles is affected and, therefore, there is a gain of 25 miles of river that is improved.

Now, not all harmful chemicals in sewage are removed by secondary biological treatment. Many such compounds are discharged directly to the streams and these primarily arise in industrial operations. The problems that they cause are combatted by applying appropriate industrial waste treatment methods that are equivalent in effectiveness to secondary treatment of municipal wastes but are not necessarily based on biological process. The combination, then, of secondary treatment of municipal wastes and the equivalent of industrial will remove a large part of the organic material which constitutes the trace organic content of surface waters, that these materials have adverse effects on many uses and are harmful in a number of ways, even including potential effect on the health of users, and for this reason secondary treatment is advantageous to the uses of surface waters apart and completely separate from the question of the amount of bacteria, the amount of BOD which may, as we heard earlier, support further growth of bacteria, and apart from the actual discharge of pathogenic organisms themselves.

That is all I have to say now.

(Dr. Rosen's written statement is as follows:)

SUMMARY OF STATEMENT BY DR. A. A. ROSEN AT CONFERENCE ON WATER QUALITY STANDARDS, IOWA - MISSOURI BASIN, COUNCIL BLUFFS, APRIL 15, 1969

I am Aaron A. Rosen. My position is: Chief, Waste Identification and Analysis Activities, Advanced Waste Treatment Research Laboratory, Federal Water Pollution Control Administration, Cincinnati, Ohio. My principal research activity at this time deals with the identification of the many organic chemical substances in municipal waste and with how they affect and are affected by various waste treatment processes.

Dr. A. A. Rosen

At the outset, let us underline the fallacy of considering municipal wastes as simply a water dispersion of human wastes. Most sewer systems also collect the wastes of many of the city's industries and businesses. Auto service stations dump large quantities of used oil into city sewers. Even households discharge many chemicals of industrial origin--detergents, disinfectants, dyes, bleaches, paint solvents, etc.

These industrial or commercial chemicals can damage the quality of a receiving stream in specific ways not related to their aggregate BOD values or their effect on dissolved oxygen. These effects can be serious at concentrations so slight that they do not appear in the figures for overall dissolved matter. Some of the adverse effects that can arise or may be suspected are: foaming, taste in drinking water (alone or with chlorine), tainting the flesh of fish, toxicity to aquatic life, and even possibly toxic or mutagenic effects on humans engaged in water sports or drinking water drawn from the affected stream. These effects are completely apart from BOD and similar effects of waste.

One of the desirable results of secondary treatment of municipal wastes, as by the activated sludge process or equivalent, is to destroy by oxidation many of the chemical compounds responsible for the kinds of harm mentioned. The compounds destroyed are biodegradable and therefore would ultimately be destroyed in the stream also, if discharged in primary effluents. But meanwhile, there will be stretches of stream damaged for some valuable uses, that would not be damaged in this way if secondary treatment had been carried out. Many factors, both chemical and hydrologic, act to determine how long the affected stretch may be.

Not all harmful chemicals in sewage are removed by secondary biological treatment, and many such compounds are discharged directly to streams. These primarily arise in industrial operations. Therefore the problems they cause must be combatted by applying appropriate industrial waste treatment methods, equivalent in effectiveness to secondary treatment of municipal wastes, but not necessarily based on a biological process.

Some of the specific chemicals that are known to or can reasonably be suspected of adversely affecting the receiving stream and that are effectively removed by secondary biological treatment are listed below.

Oxidizable Waste Materials that May Cause Taste and Odor or Affect Fish

Phenols: phenol, cresols, o-chlorophenol, 1-naphthol, p-chlorophenol

Alcohols: amyl, butyl, most aliphatic

Aldehydes: formaldehyde, furfural

Acids: formic, valeric

Ketones: most aliphatic (used in paint solvents), acetophenone

N-compounds: pyridine, picolines

Petroleum and hydrocarbons (trapped in sludge, not oxidized).

Oxidizable Waste Materials With Potential Physiological Effects

Detergents: Especially LAS, causes pronounced foam, affects fish

Cyanides: NaCN, acetonitrile, benzonitrile, adiponitrile, lactonitrile

N-compounds: acrylamide, diethanolamine

Natural hormones: progesterone, estrone, 17-B-estradiol, androsterone, 17-α-methyltestosterone, etc.

Dr. A. A. Rosen

Synthetic (contraceptive) hormones: ethynyl estradiol, mestranol (ethynyl estradiol-3-methyl ether), ethynodiol diacetate, chlormadinone, etc.

Detergent builders: nitrilotriacetic acid (NTA) (this substance chelates heavy metals and can cause their carry over in primary effluents)

Carcinogens: Polynuclear hydrocarbons, aromatic amines, dioxane.

Conclusion: The above lists show that there are many specific chemical substances, occurring more than rarely in municipal wastes, that have serious observed or potential effects, too serious to be tolerated, when discharged into receiving waters in the form of primary effluent. These substances are very greatly reduced in abundance during secondary biological treatment. The removal of such substances justifies secondary treatment apart from the basic objectives of removing BOD and eliminating microbiological pathogens.

- - -

MR. STEIN: Thank you, Dr. Rosen.

MR. BLOMGREN: Our next statement, Mr. Chairman, will be given by Robert W. Sharp, Regional Supervisor for the Division of Fishery Services, Bureau of Sport Fisheries and Wildlife, Minneapolis, Minnesota.

STATEMENT BY ROBERT W. SHARP
REGIONAL SUPERVISOR, DIVISION OF FISHERY SERVICES
BUREAU OF SPORT FISHERIES AND WILDLIFE
MINNEAPOLIS, MINNESOTA

MR. SHARP: Mr. Chairman, ladies and gentlemen.

My name is Robert W. Sharp, representing the Bureau of Sport Fisheries and Wildlife of the Department of the Interior. To those of you unfamiliar with our activities, we are the Federal fish and wildlife agency, in close cooperation with the Iowa Conservation Commission.

The Bureau of Sport Fisheries and Wildlife has a major interest in the fish and wildlife resources of Iowa and the water quality necessary for the well being of these resources. The Bureau operates four national wildlife refuges and three national fish hatcheries within the State. For many years, the Bureau has worked closely with the Iowa Conservation Commission in cooperative ventures in fish and wildlife management. As the Federal fish and wildlife agency, our interest in these proceedings is to see that the waters of Iowa are maintained at such quality to provide maximum fishing and hunting opportunities for the people of the State.

To further clarify our stand on the matters before this hearing, it is the position of the Bureau of Sport Fisheries and Wildlife that the ultimate goal of the clean waters program of this Nation should be to maintain or achieve such quality in every stream, lake, estuary, bay or other water as will support the full potential of that water for production and human use of aquatic life and water-dependent wildlife resources. To the extent that a State standard or classification of waters as to use falls short of this goal, this Bureau disapproves of that standard and that classification.

The 1,600 miles of meandered Iowa rivers represent a major aquatic resource, the basis for much of the water-based recreation of the State, fishing, hunting, boating, water skiing, swimming, as well as an important source of domestic and industrial water.

Iowa lists 52,353 acres of surface waters in its interior streams (National Survey of Hatchery Fish Needs, 1969), plus an additional 190,000 acres in Mississippi River boundary waters and 13,500 acres in Missouri River boundary waters. The 414,921 fishermen listed for the State (1967) exerted 3,456,000 man-days of angling pressure, 53 percent of this on the rivers of the State. Total man-days of angling are expected to increase to 3-1/2 million in 1973 and 3-3/4 million in 1980.

Due to markedly different physical characteristics, the Missouri River provides a less varied aquatic habitat than the Mississippi River, and it lacks the wide range of species found in the Upper Mississippi River. Nevertheless, it supports a rather varied fish population of interest to sport and commercial fishermen. The principal species are:

White crappie
Black crappie
Channel catfish
Flathead catfish
Paddlefish

R. W. Sharp

White bass
Walleye
Sauger
Largemouth bass
Bluegill
Bullhead, several species
Yellow perch
Northern pike
Green sunfish
Freshwater drum, or sheepshead as they
    are known
Gar
Carp
Buffalofish, two species
Goldeye
Redhorse
And many small species of forage minnows
    that the fishermen people call the
    Cyprinids.

Many of these species are found in the interstate streams of western Iowa, tributary to the Missouri River. The Rock River is a unique stream, somewhat atypical of western Iowa, its good quality water supporting smallmouth bass, channel catfish, sauger, and walleye. The Little Sioux and the Big Sioux Rivers support a sport fishery for channel catfish, smallmouth bass, sauger, northern pike, walleye, and secondary species. Stream channelization in the lower reaches of some of these streams has reduced the quality of the habitat. Pollution is a limiting factor in others, particularly in the Big Sioux and originating, I might say, in the

State of South Dakota. In the better quality reaches of these streams, the catch rate compares favorably with that of similar warm-water fish habitats elsewhere, 0.4 to 1.8 fish per hour. The smaller streams crossing the Iowa line, such as the Tarkio and the Nodaway, are mainly bullhead-channel catfish waters.

Mr. Chairman, at the Davenport hearing the Bureau presented a considerable volume of material on the temperature requirements of fishes. In the interest of saving time, I will attempt to paraphrase and condense this material.

MR. STEIN: But your statement will appear in full as if read.

MR. SHARP: Very well, sir.

In summary, temperature is the most important but least discussed parameter in determining water quality. A stream or lake may thrive or die because of water temperature factors.

The rapidly expanding use of streams for industrial and domestic purposes is artificially warming the surface waters of the United States. As an example, the mean annual temperature of the Mississippi River at

St. Paul, Minnesota, rose three degrees from 1923 to 1962, from 51 degrees in that year to 54 degrees in 1962. This rise in water temperature occurred in the face of a four degree drop in the mean air temperature over the same period.

The water temperature is a critical factor in the life of fish and other water organisms and consequently in fish production. It affects to a considerable degree respiration, growth, and reproduction of fish.

Each species of fish has a thermal tolerance zone in which it behaves in a normal manner; also there is a zone of higher temperature and one of lower temperature in which the species can survive for a certain length of time. A gradual and regular acclimation allows certain species to survive in temperatures that would be fatal if they occurred suddenly. Fish adapt themselves quickly to a rise in temperature, but less easily to a drop in temperature.

A distinction must be made between tolerable environmental conditions determined experimentally in the laboratory and those conditions under which fish can be expected to occur and thrive in nature. Their ability merely to survive under unnatural experimental conditions requiring no sustained activity obviously is not a reliable indication that the quality of the medium is satisfactory. The optimum temperature for activity of a species does not necessarily bear any relationship to its lethal temperature. Temperature extremes or sudden changes are often lethal. Elevated sub-lethal temperatures may induce estivation and a depressed one - hibernation.

In general, the upper limits are more quickly critical than the lower limits, despite the fact that many organisms appear to function more efficiently toward the upper limits of their tolerance ranges.

The preferred temperature range of some of the common fishes of Iowa may be of interest. Preferred temperatures, again, I repeat, of the blue gill, 90.2 degrees--all of these in Fahrenheit--the largemouth bass 86 to 89.6, the carp 89.6, the pumpkinseed sunfish 88.7, smallmouth bass, 82.4, yellow perch, 75.6, the green sunfish 81.2.

The preferred temperature and temperature for optimum activity and growth in warm-water species of interest are, for the most part, considerably below the maximum allowable limit of 93°F. (33.9 C.) which is recommended in many water quality standards. Although probably not lethal to most warm-water species, a temperature of 93°F., if maintained for a long period, would probably reduce activity and growth and ultimately be detrimental to many of the warm-water species.

A 93° upper temperature limit is considered unacceptably high for most of the year. This upper limit, being above the median tolerance limit for many aquatic organisms, does not begin to consider the synergistic effects of temperature and other pollutant conditions which might be present in given situations. The fact that 90°F. may be approached and/or exceeded under natural conditions does not justify allowing thermal wastes to duplicate or aggravate an unhealthy aquatic condition.

Equally important, from the aquatic life standpoint, is the fact that any single upper temperature limit (even one lower than 90°) represents a very unsatisfactory solution to the problem of establishing temperature standards. Such a single upper limit does not take into consideration normal, subtle aquatic life patterns, which involve gradual warming periods, and temperature plateaus. In other words, an upper limit that would be perfectly satisfactory in July or August would represent a wide-open license for thermal pollution during the rest of the year.

The effects of temperature on reproduction of fishes is of interest here.

Many temperate zone fishes take their seasonal cues for specific behavioral sequences from the length of the daily photo period acting in conjunction with the temperature. In addition to maximum temperature in summer, many water quality standards also state a limit on winter maximum or a maximum rise above ambient. While the evidence is limited, low temperatures do appear necessary, in some species at least, for normal development of the germ cells. Available evidence suggests that winter temperatures should not rise above 60°, while 50° is more preferable in northern latitudes.

The winter maximum is apparently the most critical temperature and must be sufficiently low to permit gonad maturation. While specific data are lacking, winter tolerance limits for game fish species apparently do exist

The egg temperature tolerance of some warm-water fishes in Iowa may be of interest.

For the walleye, the optimum range 62 degrees to 67 degrees Fahrenheit. Larvae die at 75 degrees.

The northern pike, optimum hatching temperature, 54 degrees to 56 degrees Fahrenheit.

The smallmouth bass, no hatch at all above 80 degrees Fahrenheit.

The largemouth bass, complete egg mortality at 90 degrees.

For northern pike--excuse me, this is repetition.

For white bass, normal hatch at 60 degrees to 70 degrees Fahrenheit.

Channel catfish, optimum spawning temperature 80 degrees Fahrenheit. Temperatures above 85 degrees lethal to eggs.

It is notable that in the rivers of England fish populations, including rough fish, were reduced when temperatures reached 86 degrees Fahrenheit, supporting observations in this country that this temperature is close to the incipient lethal level for many warm-water fish and their associated biota.

Direct thermal death of fish is not believed to be significant ecologically. Except in unusual cases of rapid temperature rise, gradual increases apparently result in avoidance of lethal temperatures by fish. The effect of temperature on growth, development and activity is usually more significant because if the sub-lethal temperature is too high for the fish to successfully reproduce, be active and grow, the ultimate failure of the population is as decisive as a lethal temperature.

The effects of temperature on fish food organisms should be considered in these circumstances. There is some evidence that plankton production, the basis for most fish food, may be disrupted or altered in normal cycle by higher than normal late winter, spring or early summer water temperatures. Low winter temperatures are apparently necessary to complete the resting stage of autumn Daphnia eggs; thus species composition of zoo plankton may change under conditions of higher

R. W. Sharp

winter temperature.

Bottom fauna organisms, another major component of fish food, may suffer from unusually high temperatures. Trembly's 1960 work in Pennsylvania indicated that 90 degrees Fahrenheit was a maximum tolerance limit at which a normal population structure of riffle macroinvertebrates could be maintained. An extensive loss in numbers, diversity and biomass occurred at a temperature greater than 90 degrees F.

Insects in deeper waters cannot emerge through heated surface waters in most cases, and snails and other animals that must come to the surface to breathe are either eliminated or have their life history interrupted.

Research results to date suggest that species of fish food organisms in general are less tolerant of high temperatures than most species of fish.

A brief comment on the need for secondary treatment.

Increasing pollution loads resulting from burgeoning human populations and expanding industrial development will impose mounting pollution loads on Iowa rivers. If these waters are to make their expected contribution to the future recreational needs of the State they should be maintained in the best possible condition. Since there will continue to be uncontrolled pollution sources, principally from agriculture, it is important that full control be exercised over pollution loadings originating from population centers. Where secondary treatment is not provided in plants, it will take place within the stream, with the resultant accumulation of sludge beds, production of hydrogen sulfide, and a general habitat degradation.

In summary, then, Mr. Chairman, the Bureau of Sport Fisheries and Wildlife endorses the requirement for secondary treatment or the equivalent for all domestic and industrial wastes discharged into the interstate waters of Iowa.

The Bureau endorses the standards for the control of added heat as set forth by the Federal Water Pollution Control Administration.

Third, many chemical compounds cause objectionable tastes and odors in fish flesh, resulting in their rejection by the fishermen. Standards should be adopted for Iowa interstate waters which will limit the concentration of these compounds to levels which will not impart unpalatable flavors or undesirable odors to fish.

And fourth and last, the Bureau endorses the principle of nondegradation of streams; that is, those waters higher in quality than established by the standards should not be permitted to decline in quality to the level of the standards.

Mr. Chairman, that concludes our statement.

(The following is the report submitted by Mr. Sharp:)

PRESENTATION BY
BUREAU OF SPORT FISHERIES AND WILDLIFE
DEPARTMENT OF THE INTERIOR, MINNEAPOLIS, MINNESOTA
Iowa Water Quality Hearings
Council Bluffs, Iowa, April 15, 1969

Introduction

The Bureau of Sport Fisheries and Wildlife has a major interest in the fish and wildlife resources of Iowa and the water quality necessary for the well being of these resources. The Bureau operates four national wildlife refuges and three national fish hatcheries within the State. For many years, the Bureau has worked closely with the Iowa Conservation Commission in cooperative ventures in fish and wildlife management. As the Federal fish and wildlife agency, our interest in these proceedings is to see that the waters of Iowa are maintained at such quality to provide maximum fishing and hunting opportunities for the people of the State.

To further clarify our stand on the matters before this hearing: It is the position of the Bureau of Sport Fisheries and Wildlife that the ultimate goal of the clean waters program of this Nation should be to maintain or achieve such quality in every stream, lake, estuary, bay or other water as will support the full potential of that water for production and human use of aquatic life and water-dependent wildlife resources. To the extent that a State standard or classification of waters as to use falls short of this goal,this Bureau disapproves of that standard and that classification.

The 1,600 miles of meandered Iowa rivers represent a major aquatic resource, the basis for much of the water-based recreation of the State, fishing, hunting, boating, water skiing, swimming, as well as an important source of domestic and industrial water.

Iowa lists 52,353 acres of surface waters in its interior streams (National Survey of Hatchery Fish Needs, 1969), plus an additional 190,000 acres in Mississippi River boundary waters and 13,500 acres in Missouri River boundary waters. The 414,921 fishermen listed for the State (1967) exerted 3,456,000 man-days of angling pressure, 53 percent of this on the rivers of the State. A seven-mile reach of the Des Moines River, west of Ames, has supported 10,000 to 13,000 fishermen hours per mile per year. Total man-days of angling are expected to increase to 3-1/2 million in 1973 and 3-3/4 million in 1980.

Due to markedly different physical characteristics, the Missouri River provides a less varied aquatic habitat than the Mississippi River, and it lacks the wide range of species found in the Upper Mississippi River. Nevertheless, it supports a rather varied fish population of interest to sport and commercial fishermen. The principal species are:

White crappie
Black crappie
Channel catfish
Flathead catfish
Paddlefish
White bass
Walleye
Sauger
Largemouth bass
Bluegill
Bullhead
Yellow perch
Northern pike
Green sunfish
Freshwater drum
Gar
Carp
Buffalofish - two species
Goldeye
Redhorse
Small Cyprinids - Minnows - Several species

Many of these species are found in the interstate streams of western Iowa, tributary to the Missouri River. The Rock River is a unique stream, somewhat atypical of western Iowa, its good quality water supporting smallmouth bass, channel catfish, sauger and walleye. The Little Sioux and the Big Sioux Rivers support a sport fishery for channel catfish, smallmouth bass, sauger, northern pike, walleye, and secondary species. Stream channelization in the lower reaches of some of these streams has reduced the quality of the habitat. Pollution is a limiting factor in others, particularly in the Big Sioux. In the better quality reaches of these streams, the catch rate compares favorably with that of similar warm-water fish habitats elsewhere, 0.4 to 1.8 fish per hour. The smaller streams crossing the Iowa line, such as the Tarkio and the Nodaway, are mainly bullhead-channel catfish waters.

Temperature Factors

Since temperature criteria are at issue, several factors should be considered in this connection.

Temperature is probably the most important but least discussed parameter in determining water quality; a stream or lake may thrive or die because of water temperature factors.

The rapidly expanding use of streams for domestic and industrial purposes is artificially warming the surface water of the United States. The mean annual temperature of the Mississippi River at St. Paul rose 3° from 1923 to 1962 (51° in 1923 to 54° in 1962). This occurred in the face of a 4° drop in mean air temperature over this period.

R. W. Sharp

The water temperature is a critical factor in the life of fish and other water organisms and consequently in fish production. It affects to a considerable degree respiration, growth and reproduction of fish.

Each species of fish has a thermal tolerance zone in which it behaves in a normal manner; also there is a zone of higher temperature and one of lower temperature in which the species can survive for a certain length of time. A gradual and regular acclimation allows certain species to survive in temperatures that would be fatal if they occurred suddenly. Fish adapt themselves quickly to a rise in temperature, but less easily to a drop in temperature.

A distinction must be made between tolerable environmental conditions determined experimentally in the laboratory and those conditions under which fish can be expected to occur and thrive in nature. Their ability merely to survive under unnatural experimental conditions requiring no sustained activity obviously is not a reliable indication that the quality of the medium is satisfactory. The optimum temperature for activity of a species

R. W. Sharp

does not necessarily bear any relation to its lethal temperature. Temperature extremes or sudden changes are often lethal. Elevated sub-lethal temperatures may induce estivation and a depressed one - hibernation.

The growth rate normally increases with temperature to a maximum and then decreases, perhaps becoming negative at temperatures approaching the lethal level.

In general, the upper limits are more quickly critical than the lower limits, despite the fact that many organisms appear to function more efficiently toward the upper limits of their tolerance ranges.

*Preferred Temperatures
(Optimum temperature for activity)

	F.	C.
Bluegill	90.2	32.3
LM bass	86-89.6	30.0-32.0
Carp	89.6	32.0
Pumpkinseed	88.7	31.5

---

* Median tolerance limit for 50 percent of the population.

	F.	C.
Goldfish	82.6	28.1
Smallmouth bass	82.4	28.0
Yellow perch	75.6	24.2
Muskellunge	75.3	24.0
Green sunfish	81.2	27.3
Fathead minnow	74.0	23.4

It is generally accepted that fish are sensitive to temperature; can recognize a change as little as 0.05 C. and readily select preferred temperatures.

The preferred temperature and temperature for optimum activity and growth in warm-water species of interest are, for the most part, considerably below the maximum allowable limit of 93°F. (33.9 C.) which is recommended in many water quality standards. Although probably not lethal to most warm-water species, a temperature of 93°F., if maintained for a long period, would probably reduce activity and growth and ultimately be detrimental to many of the warm-water species.

A 93° upper temperature limit is considered unacceptably high for most of the year. This upper limit, being above the *TLM for many aquatic organisms, does not begin to consider the synergistic effects of temperature and other pollutant conditions which might be present in given situations. The fact that 90°F. may be approached and/or exceeded under natural conditions does not justify allowing thermal wastes to duplicate or aggravate an unhealthy aquatic condition.

Equally important, from the aquatic life standpoint, is the fact that any single upper temperature limit (even one lower than 90°) represents a very unsatisfactory solution to the problem of establishing temperature standards. Such a single upper limit does not take into consideration normal, subtle aquatic life patterns. which involve gradual warming periods, temperature plateaus. etc. In other words, an upper limit that would be perfectly satisfactory in July or August would represent a wide-open license for thermal pollution during the rest of the year.

Effects of Temperature on Reproduction of Fishes

Many temperate zone fishes take their seasonal cues for specific behavioral sequences from the

---

* Median tolerance limit for 50 percent of the population.

length of the daily photo period acting in conjunction with the temperature. In addition to maximum temperature in summer, many water quality standards also state a limit on winter maximum or a maximum rise above ambient. While the evidence is limited, low temperatures do appear necessary, in some species at least, for normal development of the germ cells. Available evidence suggests that winter temperatures should not rise above 60°, with 50° being more preferable in northern latitudes.

The winter maximum is apparently the most critical temperature and must be sufficiently low to permit gonad maturation. While specific data are lacking, winter tolerance limits for game fish species apparently do exist.

Egg Temperature Tolerance of Some Common Warm-Water Fishes

Walleye	Optimum 62° - 67°F. Larvae die at 75°.
Northern pike	Optimum hatching temperature-54° to 56°F.
Smallmouth bass	No hatch above 80°F.

R. W. Sharp

Egg Temperature Tolerance of Some Common Warm-Water Fishes (Continued)

Largemouth bass	Complete mortality at 90°F. Survival best at 60.5°F.
White bass	Normal hatch at 60° to 70°F.
Channel catfish	Optimum spawning temperature 80°F. Temperatures above 85°F. apparently lethal to eggs.

Lethal Temperature Data

Species	*Upper Incipient Lethal Temperature		**Lethal Temperature	
	F.	C.	F.	C.
Channel catfish	90.0	32.5	92.3	33.5
LM bass	--	--	97.5	36.4
Bluegill	--	--	92.8	33.8
Fathead minnow	--	--	91.8	33.2
Brown bullhead	--	--	97.7	36.5
Rock bass	--	--	98.0	36.7
Common white sucker	84.7	29.3	--	--
Western blacknose dace	84.7	29.3	--	--

---

* Where a lethal effect is first noticed.

** Some of these appear high and are apparently based on short exposure times.

Species	*Upper Incipient Lethal Temperature		**Lethal Temperature	
	F.	C.	F.	C.
Northern creek chub	86.5	30.3	--	--
Bluntnose minnow	91.9	33.3	--	--
Common shiner	87.8	31.0	--	--
Lake Emerald shiner	87.3	30.7	--	--
Yellow perch	85.5	29.7	--	--
Pumpkinseed sunfish	--	--	102.0	38.9

The tolerance of Centrarchid fishes (sunfish group) is apparent; the Cyprinids (minnows) less tolerant, with the catfish group between these two.

It is notable that in the rivers of England fish populations including rough fish were reduced when temperature reached 86°F., supporting observations in this country that this temperature is close to the incipient lethal level for many warm-water fish and their associated biota.

There are four indices that determine the tolerance of a fish species to raised temperatures:

1. The upper lethal temperature for adults.

2. Temperatures (the range) that will allow satisfactory growth to maturity and spawning.

3. Temperature (range) for satisfactory development of eggs and fry.

4. Temperatures that permit normal development of fish food organisms.

Effect of Heat Barriers - Migratory species may be halted by an unfavorable barrier in a stream, a possible factor in walleye and sauger management.

Thermal death of fish is not believed to be significant ecologically. Except in unusual cases of rapid temperature rise, gradual increases apparently result in avoidance of lethal temperatures by fish. The effect of temperature on growth, development, and activity is usually more significant because if the sub-lethal temperature is too high for the fish to successfully reproduce, be active and grow, the ultimate failure of the population is as decisive as a lethal temperature.

Effects of Temperature on Fish Food Organisms

There is some evidence that plankton

production, the basis for most fish food, may be disrupted or altered in normal cycle by higher than normal late winter, spring, or early summer water temperatures. Low winter temperatures are apparently necessary to complete the resting stage of autumn Daphnia eggs, thus species composition of zoo plankton may change under conditions of higher winter temperature.

Bottom fauna organisms, another major component of fish food, may suffer from unusually high temperatures. Trembly's 1960 work in Pennsylvania indicated that 90°F. was a maximum tolerance limit at which a normal population structure of riffle macroinvertebrates could be maintained. An extensive loss in numbers, diversity, and biomass occurred at temperatures greater than 90°F. (32.2 C.)

Insects in deeper water cannot emerge through heated surface waters in most cases, and snails and other animals that must come to the surface to breathe are either eliminated or have their life history interrupted.

Research results to date suggest that species of fish-food organisms, in general, are less tolerant of high temperatures than most species of fish.

Disease and Parasitism at Higher Temperatures

Evidence would suggest that disease and parasitism of fish may be a greater factor at higher temperatures, but data on the subject remains scattered and inconclusive at the present time.

Need for Secondary Treatment

Increasing pollution loads resulting from burgeoning human populations and expanding industrial development will impose mounting pollution loads in Iowa rivers. If these waters are to make their expected contribution to the future recreational needs of the State. they should be maintained in the best possible condition Since there will continue to be uncontrolled pollution sources, principally from agriculture, it is important that full control be exercised over pollution loadings originating from population centers. Where secondary treatment is not provided, it will take place within the stream, with the resultant accumulation of sludge beds, production of H_2S, and habitat degradation.

The effectiveness of the three phases of sewage treatment are listed below:

Primary:

BOD - 20*

Suspended Solids - 60

Nitrogen - 15

Phosphorus - 15

Secondary:

BOD - 95

Suspended Solids - 95

Nitrogen - 40

Phosphorus - 40

Tertiary:

BOD - 99

Suspended Solids - 99

Nitrogen - 99

Phosphorus - 99.

In summary, the Bureau of Sport Fisheries and Wildlife endorses the requirement for secondary treatment or the equivalent of all domestic and industrial wastes discharged into the interstate waters of Iowa.

---

* Percent of waste removed. Source - Walter K. Johnson, Associate Professor of Civil Engineering, University of Minnesota, Minneapolis, Minnesota.

The Bureau endorses the standards for the control of added heat as set forth by the Federal Water Pollution Control Administration.

Many chemical compounds cause objectionable tastes and odors in fish flesh, phenolic compounds, hydrocarbons, gas wastes, alcohols, and petroleum refinery wastes are the worst offenders, sometimes to the point of causing rejection of the fish by the angler. Standards should be adopted for Iowa interstate waters which will limit the concentration of these compounds to levels which will not impart unpalatable flavors or undesirable odors to fish.

The Bureau endorses the principle of nondegradation of streams--that is, those waters higher in quality than established by the standards should not be permitted to decline in quality to the level of the standards.

R. W. Sharp

References - Temperature Material

Brown. 1957. Physiology of Fishes. Volumes 1 and 2.

Lagler, Bardach and Miller. 1963. Icthyology.

Odum. 1964. Fundamentals of Ecology.

Storer. 1951. General Zoology.

Tarzwell, C. M. 1962. Biological Problems in Water Pollution. 3rd Seminar. 1962. Department of Health, Education, and Welfare. U. S. Public Health Service.

Calhoun, Alex. 1966. Inland Fisheries Management. California Department of Fish and Game.

UMRCC. 1967. Fisheries Compendium - Upper Mississippi River.

Welch, E. B. and T. A. Wojtalik. 1968. Some Effects of Increased Water Temperature on Aquatic Life T.V.A. Division of Health and Safety - Water Quality Branch. Chattanooga, Tenn.

Blakely, J. F. 1966. Temperature of Surface Waters in Conterminous U. S. U. S. Geological Survey.

Bureau of Sport Fisheries and Wildlife. 1969. National Survey of Hatchery Fish Needs.

F.W.P.C.A. 1968. Industrial Waste Guide on Thermal Pollution.

- - -

MR. STEIN: Thank you, Mr. Sharp. At this point we will recess for lunch and reconvene promptly at 1:30.

(NOON RECESS)

AFTERNOON SESSION

MR. STEIN: Let's reconvene.

Mr. Blomgren.

MR. BLOMGREN: Mr. Chairman, at this time I will introduce our next person presenting a statement.

Mr. Kenneth Roberts, Fishery Biologist, Bureau of Commercial Fisheries, Ann Arbor, Michigan.

Kenneth.

STATEMENT BY KENNETH ROBERTS
FISHERY BIOLOGIST, BUREAU OF COMMERCIAL FISHERIES, U. S. DEPARTMENT OF THE INTERIOR
ANN ARBOR, MICHIGAN

MR. ROBERTS: Mr. Chairman, ladies and gentlemen.

I am Kenneth R. Roberts, representing the U. S. Bureau of Commercial Fisheries. I have a prepared statement for the record, from which I am going to read excerpts. However, Mr. Chairman, I would like the entire statement in the record.

MR. STEIN: Without objection, that will be done as if read.

K. R. Roberts

MR. ROBERTS: Iowa lies in the center of the traditional Mississippi-Missouri River commercial fishery. During the late 1890's Iowa was one of the foremost States of the interior United States in commercial fish production. Both the Missouri and Mississippi Rivers and certain tributaries were fished extensively. Records indicate the waters in 1901 were well supplied with fish in great variety and abundance.

On the Missouri River as it flows through or by Iowa, Kansas, Nebraska and Missouri, the outstanding trend has been a progressive decline in annual production from 1908 to the present. This trend is readily observable in Table 1, which summarizes commercial catch for these States. In 1963 total production was 12 percent that of the 1908 catch, although showing roughly constant percentages of the three primary groups--carp, catfish and buffalofish. Over the period 1954-63, Iowa landings from the Missouri River, although somewhat fluctuating, have averaged only 66,000 pounds, valued at roughly $9,000.

There has been extensive reduction of river surface area as a result of channel development as well as a progressive degradation of Missouri water quality.

K. R. Roberts

Primary pollutants include: sewage discharges, rendering plant wastes, animal wastes, accidental spills and discharges of oil, gasoline, grease and other chemicals and compounds and fertilizer runoff. Although economic and institutional factors have played an important role in the generally downward trend of commercial fishery production, water quality problems have further aggravated an already difficult situation. At various places and times the introduction of waste materials which directly or indirectly impart undesirable taste and odor characteristics to fish has seriously limited the marketability of the catch. Under such circumstances, one more element of risk is added to the commercial fishing operation as markets are lost and fishing is temporarily halted in the affected stream stretch. This is a serious problem for an industry whose products are sold for human consumption.

Iowa's Missouri River commercial fishing industry has clearly been vulnerable to a progressive trend of river habitat degradation and will continue to be sensitive to fluctuations in water quality. The effects of increased water temperature, overenrichment, and industrial wastes which are lethal to aquatic organisms or which cause undesirable taste and odor in food fishes are of particular significance. Thus, it is important that adequate standards be defined and adopted for application to interstate waters of Iowa.

With respect to temperature: Perhaps more than any other environmental factor, temperature has multiple and diverse effects on aquatic organisms. It limits the distribution of aquatic organisms and at the same time determines their level of activity. Sharp or long-lasting temperature changes cause new biological systems to appear, and old ones to vanish.

We need not ordinarily be concerned so much about high (or low) temperatures that are immediately lethal as about the effects of chronically sublethal temperatures whose effects are delayed but ultimately just as dramatic. In the long run, temperature levels that adversely affect the animals' metabolism, feeding, growth, reproduction, and other vital functions are just as harmful as rapid heat death.

Occasionally the question of potential beneficial side effects on fishery resources from heated water effluents is raised. For example, it is often pointed out that heated effluents do at certain times attract fish, and they may become more available for angler harvest. But looking beyond this seeming benefit, what harmful effects are at the same time imparted to the river? The same heated water may disrupt important life history patterns and create a net negative ecological effect upon the river. What good is fish attraction under these circumstances? With all due respect to the eventual beneficial uses of heated effluents, one is hard pressed to find one such use which is sufficiently well developed or defined to be useful in making a midwestern water area ecologically more desirable within the next 20 years. In other words, harnessing of benefits is years off, while the potential damages of these effluents are here now. As with badly needed studies of potential dangers, constructive use of potential benefits will require research and investigation. Thus, it is necessary that realistic temperature standards be set at this time which will protect aquatic life.

With respect to nutrients: The more abundant the nutrient supply, the more dense the aquatic vegetative growth, provided other environmental factors

K. R. Roberts

are favorable. Substances involved are nitrogen, phosphorus, carbon, vitamins and other compounds and elements. In aquatic habitat, such substances stimulate growth of bacteria, fungi, phytoplankton, filamentous algae, and submerged, submersed, floating, and marginal water plants. Excess nutrients readily create conditions undesirable from the fishery standpoint. Resulting growths can interfere with commercial fishing by fouling lines and clogging nets. Excess metabolic demands of such plants while they are living and their decomposition after death impose a high BOD load on the streams and are capable of severely reducing and even depleting dissolved oxygen. Dense growths of filamentous algae and other plants can seriously reduce total fish production, as well as interfere with harvest of fish.

Available information shows that excess amounts of nutrients and other wastes are entering the Missouri River and its tributaries and causing substantial degradation of water quality. The FWPCA's 1967 biological survey of the Missouri River from Sioux City, Iowa, to Herman, Missouri, showed that at least 54 of the 286 river miles were severely degraded by pollution. Severely degraded waters were also found in the Missouri River tributaries of the Big Sioux, Floyd, Soldier and Boyer Rivers.

Reduction of nutrient levels in the affected stretches and tributaries of the Missouri River can provide considerable benefits to the commercial fishery. Quantitatively, fish production may increase. Qualitatively, a large measure of stability would be added to the commercial fishery as periodic fish kills and cases of tainting are reduced or limited. The capability exists within reach of present technology to greatly eliminate inputs of nitrogen, phosphorus, organic residues and suspended solids from sewage and industrial effluents. From the standpoint of the fishery resource it is desirable and necessary that such elimination be effected.

With respect to taste-and odor-inducing substances: A large number of compounds can impart objectionable tastes and odors to fish flesh. These compounds include: hydrocarbons, phenolic compounds, coal tar wastes, gas wastes, sewage containing phenols, and petroleum refinery wastes. It has been found that chlorophenol could produce unpleasant flavor in fish at a water concentration of one part per billion. Apparently certain algaes are also capable of imparting taste and odor to fish flesh.

Occasional spills of chemicals and other substances on the Missouri River and its tributaries have rendered commercial catches unsaleable due to taste and odor problems. Certain reaches of the Missouri River and its tributaries are from time to time unsuitable for commercial production because fish present have been rendered unmarketable. Taste and odor problems are serious problems to the commercial fisherman. Since phenols, oil and other taste-inducing compounds are potential destructive contributors, it is desirable that standards be adopted for Iowa interstate waters which will limit the concentrations of these substances to levels which will not impart unpalatable flavors or undesirable odors to fish.

In conclusion, on August 7, 1967, a memorandum summarizing the Bureau of Commercial Fisheries' comments on Iowa's proposed criteria were forwarded to the Regional Director of the Missouri Basin Region, Federal Water Pollution Control Administration. The subjects of criteria for temperature and undesirable tastes in edible aquatic organisms are covered in the memorandum. Since these aspects are of prime importance at this hearing, we wish to emphasize that our present views are basically the same as those advanced on August 7, 1967. We wish to emphasize further that our views past and present are essentially identical to those being advanced for secondary treatment, temperature, phenols and protection of high quality waters by the FWPCA at this hearing. Therefore, we firmly endorse and support the FWPCA recommendations as they will soon be presented by Mr. Blomgren.

A great deal has yet to be learned about adequate aquatic life criteria, and additional research may demonstrate the need for redefinition and refinement of the standards to meet fishery requirements. Until careful research demonstrates beyond a reasonable doubt that degradation of existing water quality to the level of the finally approved standards will not result in harmful effects upon fish and aquatic life resources, it is the position of the BCF that the goal of pollution abatement should be maintenance or improvement of water quality in the waters under consideration at this hearing. Therefore, BCF also endorses the Federal Water Pollution Control Administration recommendation for an anti-degradation clause in the final Iowa standards.

Thank you.

MR. STEIN: Thank you, Mr. Roberts.

(The following is the report submitted by Mr. Roberts:)

STATEMENT PRESENTED BY THE BUREAU OF COMMERCIAL FISHERIES, U. S. DEPARTMENT OF THE INTERIOR, 5 RESEARCH DRIVE, ANN ARBOR, MICHIGAN, AT THE DEPARTMENT OF INTERIOR WATER QUALITY STANDARDS CONFERENCE ON IOWA INTERSTATE WATERS OF THE MISSOURI RIVER, APRIL 15, 1969, COUNCIL BLUFFS, IOWA.

Iowa lies in the center of the traditional Mississippi-Missouri River commercial fishery. During the late 1890's Iowa was one of the foremost States of the interior United States in commercial fish production. Both the Missouri and Mississippi Rivers and certain tributaries were fished extensively. Records indicate the waters in 1901 were well supplied with fish in great variety and abundance.

On the Missouri River as it flows through or by Iowa, Kansas, Nebraska and Missouri, the outstanding trend has been a progressive decline in annual production from 1908 to the present. This trend is readily observable in Table 1, which summarizes commercial catch for these States. In 1963 total production was 12 percent that of the 1908 catch, although showing roughly constant percentages of the three primary groups--carp, catfish and buffalofish. Over the period 1954-63, Iowa landings from the Missouri River, although somewhat fluctuating, have averaged 66,000 pounds, valued at $9,000.

There has been extensive reduction of river surface area as a result of channel development as well as progressive degradation of Missouri water quality. Primary pollutants include: sewage discharges, rendering plant wastes, animal wastes, accidental spills and discharges of oil, gasoline, grease, and other chemicals and compounds and fertilizer runoff. Although economic and institutional factors have played an important role in the generally downward trend of commercial fishery

TABLE 1.--MISSOURI RIVER COMMERCIAL FISH PRODUCTION IN THOUSANDS OF POUNDS FOR THE STATES OF IOWA, KANSAS, NEBRASKA, AND MISSOURI (1894-1965)*

YEAR	STATE				TOTAL
	IOWA	KANSAS	NEBRASKA	MISSOURI	
1894	564	134	311	570	1,579
1898	257	107	309	712	1,385
1908	144	431	399	1,302	2,276
1922	167	54	136	314	671
1931	132	143	145	169	589
1954	13	112	212	163	500
1955	30	145	194	166	535
1956	16	115	268	138	536
1958	143	78	127	151	499
1959	141	63	151	152	507
1960	136	60	123	154	473
1962	36	52	129	98	315
1963	11	44	131	86	272
1964**	321	38	281	105	745
1965**	42	42	422	106	612

*Taken from Fishery Statistics of the U.S., U.S. Bureau of Commercial Fisheries, 1894-1965.

**Production data for certain inland waters have been included in these data.

production, water quality problems have further aggravated an already difficult situation. At various places and times the introduction of waste materials which directly or indirectly impart undesirable taste and odor characteristics to fish has seriously limited the marketability of the catch. Under such circumstances, one more element of risk is added to the commercial fishing operation as markets are lost and fishing is temporarily halted in the affected stream stretch. This is a serious problem for an industry whose products are sold for human consumption.

Iowa's Missouri River commercial fishing industry has clearly been vulnerable to a progressive trend of river habitat degradation and will continue to be sensitive to fluctuations in water quality. The effects of increased water temperature, overenrichment and industrial wastes which are lethal to aquatic organisms or which cause undesirable taste and odor in food fishes are of particular significance. Thus, it is important that adequate standards be defined and adopted for application to interstate waters of Iowa.

K. R. Roberts

TEMPERATURE

Temperature, perhaps more than any other environmental factor, has multiple and diverse effects on aquatic organisms. It limits the distribution of aquatic organisms and at the same time determines their level of activity. Sharp or long-lasting temperature changes cause new biological systems to appear, and old ones to vanish.

We need not ordinarily be concerned so much about high (or low) temperatures that are immediately lethal as about the effects of chronically sublethal temperatures whose effects are delayed but ultimately just as dramatic. In the long run, temperature levels that adversely affect the animals' metabolism, feeding, growth, reproduction, and other vital functions are just as harmful as rapid heat death.

There is a lack of specific information required to determine the total effects of heated effluents on aquatic ecology. However, a good deal is known about the effects of temperature changes on aquatic organisms. Basically, water temperature influences the rate of all biochemical reactions, the solubility and rate of oxygen uptake, metabolism, the heart beat, viscosity of body fluids, permeability of membranes, and even the volume of gas in the swim bladder of fishes. Besides acting as a lethal factor, increased temperatures have been demonstrated to: interfere with normal incubation periods of fish eggs; disrupt reproductive cycles; accelerate weight loss; inhibit maturation of fish and other organisms; aggravate parasitic infections; induce bacterial epidemics; disrupt normal activity patterns; decrease appetite, digestion rate, and growth; induce respiratory difficulties; and increase oxygen consumption. In addition, temperature increases can: synergize effects of pesticides, heavy metals, dissolved gases, detergents, sulfite waste liquors, and other toxic or debilitating pollutants; decrease dissolved oxygen content of water; and under certain conditions may also accentuate development of algal blooms, particularly bluegreen species.

Occasionally the question of potential beneficial side effects on fishery resources from heated water effluents is raised. For example, it is often pointed out that heated effluents do at certain times attract fish, and they may become more available for angler harvest. But looking beyond this seeming benefit, what harmful effects are at the same time imparted to the river? The same heated water may disrupt important life history patterns and create a net negative ecological effect upon the river. What good is fish attraction under these circumstances? With all due respect to the eventual beneficial uses of heated effluents, one is hard pressed to find one such use which is sufficiently well developed to be useful in making a midwestern water area ecologically more desirable within the next 20 years. In other words, harnessing of benefits is years off, while the potential damages of these effluents are here now. As with badly needed studies of potential dangers, constructive use of potential benefits will require research and investigation. Thus, it is necessary that realistic temperature standards be set which will protect aquatic life.

NUTRIENTS

The more abundant the nutrient supply, the more dense the aquatic vegetative growth, provided other environmental factors are favorable. Substances involved are nitrogen, phosphorus, carbon, vitamins and other compounds and elements. In aquatic habitat, such substances stimulate growth of bacteria, fungi, phytoplankton, filamentous algae, and submerged, submersed, floating, and marginal water plants. Excess nutrients readily create conditions undesirable from the fishery standpoint. Resulting growths can interfere with commercial fishing by fouling lines and clogging nets. Excess metabolic demands of such plants while they are living and their decomposition after death impose a high BOD load on the streams and are capable of severely reducing and even depleting dissolved oxygen. Dense growths of filamentous algae and other plants can seriously reduce total fish production, as well as interfere with harvest of fish.

Available information shows that excess amounts of nutrients and other wastes are entering the Missouri River and its tributaries and causing substantial degradation of water quality. The FWPCA 1967 biological survey of the Missouri River from Sioux City, Iowa, to Herman, Missouri, showed that at least 54 of the 286 river miles were severly degraded by pollution. Severely degraded waters were also found in the Missouri River tributaries of the Big Sioux, Floyd, Soldier and Boyer Rivers. In the areas of severe biological habitat degradation, most benthic organisms found were those associated with polluted waters. Nutrient levels adequate to support undesirable biological growths as well as excessive numbers of coliform bacteria were found downstream from Sioux City, Iowa. Available data show the Nebraska-Iowa-Missouri reach of the Missouri River at times carries an organic pollution load which exceeds by 10 times the human population of the entire basin. The balance is caused by agricultural and natural sources. The main agricultural sources of pollution are: (1) sediments; (2) nutrients; (3) chemicals; and (4) animal wastes.

Reduction of nutrient levels in the affected stretches and tributaries of the Missouri River can provide considerable benefits to the commercial fishery. Quantitatively, fish production may increase. Qualitatively, a large measure of stability would be added to the commercial fishery as periodic fish kills and cases of tainting are reduced or limited. The capability exists within reach of present technology to greatly eliminate inputs of nitrogen, phosphorus, organic residues and suspended solids from sewage and industrial effluents. From the standpoint of the fishery resource it is desirable and necessary that such elimination be effected.

TASTE- AND ODOR-INDUCING SUBSTANCES

A large number of compounds can impart objectionable tastes and odors to fish flesh. These compounds include: hydrocarbons, phenolic compounds, coal tar wastes, gas wastes, sewage containing phenols, and petroleum refinery wastes. It has been found that chlorophenol could produce unpleasant flavor in fish at a water concentration of only 0.0001. Apparently certain algaes are also capable of imparting taste and odor to fish flesh.

Occasional spills of chemicals and other substances on the Missouri River and its tributaries have rendered commercial catches unsaleable due to taste and odor problems. Certain reaches of the Missouri River and its tributaries are from time to time unsuitable for commercial production because fish present have been rendered unmarketable. Taste and odor problems are serious problems to the commercial fisherman. Since phenols, oil, and other taste-inducing compounds are destructive contributors, it is desirable that standards be adopted for Iowa interstate waters which will limit the concentrations of these substances to levels which will not impart unpalatable flavors or undesirable odors to fish.

CONCLUSIONS

The Bureau of Commercial Fisheries has been involved for many years with the water quality aspects of fishery research through its Biological Laboratories. We are, therefore, very concerned with the impact of pollution on the total fishery environment.

As a result of the Water Quality Act of 1965, the Bureau and a number of other Federal water resources agencies were called upon to review and comment upon Iowa's proposed Water Quality Criteria and Plan of Implementation, May 1967. On August 7, 1967, a memorandum summarizing BCF's comments on Iowa's proposed criteria was forwarded to the Regional Directors of the Great Lakes and Missouri Basin Regions, Federal Water Pollution Control Administration. A copy of that memorandum is attached as Appendix A.

The subjects of criteria for temperature and undesirable tastes in edible aquatic organisms are covered in the memorandum. Since these aspects are of prime importance at this hearing, we wish to emphasize that our present views are basically the same as those advanced on August 7, 1967. We wish to emphasize further that our views past and present are essentially identical to those being advanced for Secondary Treatment, Temperature, Phenols, and Protection of High Quality Waters by the FWPCA at this hearing. Therefore, we firmly endorse and support the FWPCA recommendations as they are proposed for this conference.

A great deal has yet to be learned about adequate aquatic life criteria, and additional research may demonstrate the need for redefinition and refinement of the standards to meet fishery requirements. Until careful research demonstrates beyond a reasonable doubt that degradation of existing water quality to the level of the finally approved standards will not result in harmful effects upon fish and aquatic life resources, it is the position of the BCF that the goal of pollution abatement should be maintenance or improvement of water quality in the waters under consideration at this hearing. Therefore, BCF also endorses the FWPCA recommendation for an anti-degradation clause in the final Iowa standards.

Appendix A. BCF Comments to FWPCA on the Water Quality Criteria and Plan of Implementation for Iowa 1967.

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA GEN. REG. NO. 27

5010-107

UNITED STATES GOVERNMENT

Memorandum

TO : Regional Directors, FWPCA, Great Lakes Region, Chicago, Illinois and Missouri Basin Region, Kansas City, Missouri

DATE: August 7, 1967

FROM : Regional Director, BCF, Ann Arbor, Michigan (Acting)

SUBJECT: BCF Comments on The Water Quality Criteria and Plan of Implementation for Iowa, May, 1967.

We have reviewed the subject submittal which you have forwarded with a request for our comments. Since the standards advanced in the submittal are common to appropriate interstate waters for both your regions, we have combined our formal response into this one memo.

1. General Comment.--Water quality standards required to maintain "healthy aquatic life" conditions in Iowa are far more complex than can be covered on one single spaced typewritten page. This fact becomes apparent after review of the ten page "...incomplete, tentative..." summary of key criteria for fresh water organisms advanced in the excellent interim report of the FWPCA's National Technological Advisory Committee on Water Quality Requirements for Fishes (hereafter referred to as the N.T.A.C. interim report). The treatment given to aquatic life criteria in the present submittal is considered inadequate, and we recommend that a more thorough aquatic life treatment be prepared and included, at least for the areas covered by the following comments, before final approval is made on the Iowa submittal.

2. Updating.--The Iowa submittal contains no formal indication that the standards specified are susceptible to future changes, when warranted by experience and future research findings. We recommend that a detailed procedure for enacting such updating be prepared and included in the submittal.

3. Definition of Terms.--The submittal includes a number of very important key words and phrases which are not adequately defined. Among these are: fish propagation (p. 4); sufficient distance downstream and adequate mixing (p. 7; also see Comment 4 of this memo); detrimental, harmful (p. 8); permanent fish population (p. 11); unsightly, deleterious (p. 13); aquatic ... use of the water (p. 14); and well balanced fish population (p. 15). We recommend that these terms, as well as other significant terms, be clearly defined and the definitions be included in an appropriate section of the submittal.

Buy U.S. Savings Bonds Regularly on the Payroll Savings Plan

4. Zones of Admixture.--Item 2 of Section 2.1 on page 7 indicates aquatic life criteria would apply at, "All points in the stream from the mouth up to the designated cutoff point...". The first sentence of page 7's last paragraph states that sampling would occur after "adequate mixing" of effluents, thus indicating aquatic life criteria are not intended to apply at all points as stated Item 2.1. These two statements of the submittal conflict literally, and involve at least in Iowa streams designated for aquatic life the difficult subject of effluent mixture areas.

As treated in the submittal, the designation of Iowa zones of admixture are arbitrary and not well defined. The terms sufficient distance downstream and adequate mixing are open to unreasonably broad interpretation. A license exists within the present wording which would permit legal use of Iowa streams for further indiscriminate disposal of wastes with resultant destruction of fishery habitat and migration patterns.

We are of the opinion that admixture of effluents in aquatic life zones can be regulated effectively using the approach advanced in ZONES OF PASSAGE AND MIXING (pages 31, 32) of the N.T.A.C. interim report. We consider this to be the most reasonable and realistic approach available and recommend its adoption in toto into the submittal.

5. Undesirable Tastes in Edible Aquatic Organisms.--Section 2.2 presently has no reference to regulation of substances in the water which will impart undesirable tastes to the flesh of fish and other edible aquatic organisms. We recommend that wording to the following extent be worked into the first paragraph of Section 2.2:

> "Taste and odor producing substances shall be limited to concentrations in the stream that will not impart unpalatable flavor to fish or other edible aquatic organisms."

6. Temperature.--The proposed 93°F upper temperature limit is considered unacceptably high for most of the year. This upper limit, being above the TLm for many aquatic organisms, does not begin to consider synergistic effects of temperature and other pollutant conditions which might be present in given situations. The fact that 93°F may be approached, and/or exceeded under thoroughly natural conditions does not justify allowing thermal wastes to duplicate or aggravate such an unhealthy aquatic life condition.

Equally important, from the aquatic life standpoint, is the fact that any single upper temperature limit (even one lower than 93°F) represents a very unsatisfactory solution to the problem of establishing temperature standards. Such a single upper limit does not take into consideration normal subtle aquatic life patterns, which involve gradual warming periods, temperature plateaus, etc. In other words, an upper limit that would be perfectly satisfactory in July or August would represent a wide open license for thermal pollution during the rest of the year.

We recommend that the water temperature criteria presented in the N.T.A.C. interim report (pages 4-6) and utilizing a standard 5°F above the monthly average of the natural maximum daily water temperatures be adopted for Iowa aquatic life zones. Maximum surface water temperatures should range between 86-90°F, depending on local stream characteristics and biota.

7. Toxic Substances.--The existing portion of the submittal concerning toxic substances is considered abbreviated and inadequate. We recommend that the standards for toxic substances advanced in the N.T.A.C. interim report (pages 11-13) be adopted *in toto* for the Iowa standards.

8. Oil and Grease.--The aspect of oil and grease pollution is not even broached in the Aquatic Life standards on page 15, although this is an extremely significant and common source of pollution. We recommend that the standards advanced in the N.T.A.C. interim report on oil (p. 8) be adopted *in toto* for Iowa waters.

We appreciate the opportunity to review and comment on the Iowa submittal. If any questions should arise concerning our comments, don't hesitate to call upon us. We would like to be advised as soon as possible on the disposition of our comments (i.e. We would like to know which are acceptable in your judgement).

Sincerely,

Ernest D. Premetz

Ernest D. Premetz

MR. STEIN: Mr. Blomgren.

MR. BLOMGREN: One additional statement to be made by Dr. Clarence Tarzwell, Director of National Water Quality, Marine Laboratory, West Kingston, Rhode Island.

Dr. Tarzwell.

STATEMENT BY DR. C. M. TARZWELL
DIRECTOR, NATIONAL MARINE WATER QUALITY LABORATORY, FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, WEST KINGSTON, RHODE ISLAND

DR. TARZWELL: Mr. Chairman, conferees, ladies and gentlemen.

I am Clarence M. Tarzwell, Director of the National Marine Water Quality Laboratory, which is the laboratory of the FWPCA at West Kingston, Rhode Island. I have a prepared statement, Mr. Chairman, which I would like to submit for the record.

MR. STEIN: Without objection, this will be done.

DR. TARZWELL: However, I shall not read

it. I shall summarize it and also emphasize some of the basic considerations which have been brought out by some of the other speakers.

Among these, I have listed eight:

No. 1. We should realize that the conditions to which organisms have become adapted over geological time have now become their environmental requirements and any change introduced by man in comparison to geological time is a rapid change and when these are sudden or large, they are significantly harmful or can be to the aquatic life.

2. I think it is basic that we must realize that dissolved oxygen and temperature must be considered together as they are interrelated. In other words, when there is a high temperature you need a high dissolved oxygen. When the dissolved oxygen is low you must also have a low temperature if you are to provide conditions which allow full activity for the aquatic organisms.

Carbon dioxide also has some influences on oxygen requirements and in turn on the effects of temperature from the standpoint of the amount of oxygen required for activity of the organisms.

No. 3. In establishing water quality standards we must consider the most sensitive species in the biota, that is the most sensitive important species. If we do not do this, the whole biota can be disrupted. In other words, the chain of life is no stronger than its weakest link, and in establishing water temperatures which are conducive to the survival, growth, reproduction, general well being, and the production of a crop, we must consider the species that are most sensitive to temperature changes and especially high temperatures. The criteria cannot be based upon the most tolerant species.

No. 4. In considering water quality requirements, we must consider the most sensitive life stages. These must be protected if an organism is to complete its life history. In other words, we must consider the temperatures for the maturation of the sex products, the spawning act, the development of the eggs, the development of the larvae or fry or nymphisms, whatever it might be. And in this regard, seasonal variations to which the organisms have become accustomed are very important. We cannot depart greatly from these and expect to have a well balanced biota.

No. 5. Peak temperatures observed in nature cannot be endured for long periods. Sometimes we have natural kills of aquatic organisms due to unusual heat. Peak temperatures which are observed in nature occur for only short periods and very often they are very near to lethal temperatures. Considering these peak temperatures as favorable is a mistake that non-biologists very often make. In the setting of peak temperatures, of course, you have to be realistic. You cannot say that aquatic organisms cannot withstand temperatures that occur naturally just because they are very close to lethal temperatures. However, it seems that many people do not realize that these peak temperatures cannot be withstood for considerable periods. Further, temperatures which can be resisted for even considerable periods by adults may be unsuited for the young and are no measure of temperatures which are favorable and necessary for the survival of the species.

Also it must be realized that in nature there are daily variations in temperature which are now environmental requirements. There is naturally a cooling off period at night. We have observed in our fishery studies that while water temperatures may be unfavorably high during the day, they can be endured if there is a cooling off period during the 24-hour cycle. Without this cooling off period, serious harm can be caused either directly or from weakening of a species so that its competitors can take over and produce an undesirable change in the fish population.

6. High temperatures in the transition periods from winter to spring can be critical and detrimental. A 10-degree increase in temperature in March and April or early May, depending on the part of the country that you are in, will convert temperatures which are normally in the 40's and 50's to temperatures which are in the 50's and 60's. This change can be very important from the standpoint of the bass which spawn after the temperatures reach 60 and are maintained at that level or above for a few days. For example, when the temperatures are in the 50's they don't spawn and if a cold spell comes and temperatures drop back down into the 40's there is no direct harm because the eggs haven't

yet been laid. However, if the water temperatures are raised 10 degrees Fahrenheit into the 60's and then drop back into the 50's, due to the cold spell the spawn for the year would be wiped out, because, as you know, the daddy bass leaves the nest when water temperatures drop below 60 degrees Fahrenheit. When this occurs, the eggs either fungus up, are eaten by other organisms or they die from lack of oxygen because the daddy bass is no longer there to keep the water circulating so they have an oxygen supply.

No. 7. In warm streams an increase of 10 degrees Fahrenheit with a 93 degree maximum can result in significant harm. If all temperatures are raised 10 degrees Fahrenheit, the minimum daily temperature will approach 90 or be in the area of 90 to 93 degrees during considerable periods in the summer. Then if the maximum temperature of 93 degrees Fahrenheit is met by the use of cooling towers, temperatures may be in the vicinity of 93 around the clock for several days or more in succession. From the evidence that has been presented by the Fish and Wildlife Service representatives, it is evident that these continued high temperatures are harmful and may be lethal.

No. 8. A rise of 10 degrees above natural temperature lengthens the hot water period and increases stress which can change the qualitative and quantitative makeup of the aquatic population. I would like to list briefly some of the effects of increased temperatures.

(a) Increased temperature speeds up metabolism and increases the need for higher dissolved oxygen concentrations. Temperature influences growth and if a temperature increase is not too great growth is more rapid. After a certain point is passed, growth is actually retarded and detrimental effects are produced. Water temperature influences the development of sex products and the time of spawning or it can inhibit spawning.

(b) High temperatures can limit the ability of water to hold dissolved oxygen. At the higher temperatures oxygen is less soluble and less oxygen is available at the time when more oxygen is needed.

(c) The higher temperatures generally favor coarse or less desirable species, dogfish, gar, shad, suckers, carp, and so forth, such as you see in many of our southern streams.

(d) High temperatures favor dense growths of undesirable algae, such as the bluegreen algae. With increase in temperatures algal growth increases up to a certain point and then with further increases in temperatures there is a succession of species, the diatoms, the greens and the bluegreens. The bluegreens are somewhat undesirable, sometimes very undesirable, from the standpoint of the fishermen for the use of the water and the fishes themselves.

(e) Increased temperatures bring about unseasonal emergence of some of the food organisms and can cause a decrease in food through limiting important species.

(f) Increased temperatures increase acute toxicity.

(g) Increased temperatures require more stringent quality standards for the other parameters.

(h) Temperature changes may produce temperature blocks to migration.

(i) High temperatures encourage most parasites and disease. Parasites and disease generally are most severe in their action when the organisms are under stress at the higher temperatures. They disrupt the delicate biological cycles in several ways.

(j) Temperatures above a certain level, depending on the species, produce sub-lethal undesirable physiological results.

(k) Temperature changes cause shifts in species and the qualitative and quantitative makeup of the biota.

In summary, I think that it is evident that in our research and investigation programs and in the setting of water quality standards for temperature it is essential to consider not only lethal but all sub-lethal and other effects. Because temperature has both direct and indirect effects, it can influence in several ways many of the other environmental requirements required for the well being and the production of aquatic life.

MR. STEIN: Thank you, Dr. Tarzwell.

(The following is the report submitted by Dr. Tarzwell:)

Dr. C. M. Tarzwell

ENVIRONMENTAL REQUIREMENTS OF AQUATIC LIFE

Settleable Solids and Turbidity

Some 17 years ago, I proposed a classification of pollutants in six groups as follows: (1) inert, inorganic and organic wastes; (2) putrescible wastes; (3) toxic wastes; (4) wastes of a significant heat content; (5) radioactive wastes; and (6) contaminants. In the first group, silt and other materials brought into streams and lakes by land erosion are the most important. In fact, not many years ago, eroded materials were the most important pollutant in our streams. In recent years, toxic materials in industrial wastes have increased greatly and are now very important. However, settleable and suspended solids and turbidity are still outstanding pollutants in our waters. These materials influence productivity in a variety of ways. Settleable solids blanket the bottom, rendering it much less productive of those organisms essential as food for the fish; shifting sand bottoms are virtual aquatic deserts; materials which settle out on sand or gravel-rubble bottoms cover and destroy spawning beds and greatly reduce productivity by filling up the spaces between the rocks. Turbidity reduces light penetration and adversely influences the photosynthetic activity of phytoplankton. Thus, increases in turbidity can constitute pollution and a decrease in turbidity is an important means of improving stream conditions.

Control of land erosion is a difficult problem, the attainment of which is largely dependent upon those agencies having to do with road building, housing developments, placer and strip mining, agriculture, grazing, forestry, fire control and coal and gravel washing. If we are to decrease this type of pollutant in our streams, we will have to initiate a multiple agency, multiple discipline program. There can be little plant life and bottom fauna where turbidity is maintained continuously above 200 Jackson Turbidity Units.

Putrescible Wastes and Dissolved Oxygen

The addition of putrescible wastes to a stream may result in minor enrichment, in enrichment which produces excessive growths and growths of undesirable organisms or blooms or the enrichment may be so great that the breakdown of the organic material by bacteria results in the depletion of oxygen and fish kills.

Dr. C. M. Tarzwell

Organic enrichment which encourages the excessive growth of filamentous algae and rooted aquatics can be detrimental from the standpoint of interfering with other uses of the water such as fishing or boating, swimming and water skiing. Algal growths may become so dense that during the day they supersaturate the water with oxygen due to photosynthetic action and at night their respiration and that of the bacteria depletes the oxygen. Wide fluctuations in oxygen levels with supersaturation due to photosynthetic action is a mark of organic enrichment and often an indication of pollution.

Dissolved oxygen levels are of outstanding importance for aquatic life. In the determination of water quality requirements for aquatic life, special attention must be given to dissolved oxygen concentrations and their variations. When minimum concentrations of dissolved oxygen are listed as water quality requirements, these minimums represent the lowest desirable concentrations and daily and seasonal fluctuations must be above these concentrations. The amount of oxygen present largely determines temperatures which may be harmful or which may be survived by the aquatic biota. As the temperatures rise, more and more oxygen is required. If oxygen levels are low, temperature levels must be kept low. In the setting of water quality criteria, therefore, temperature and oxygen levels must be interrelated.

Temperature Requirements for Aquatic Life

Temperature is a very important factor in the aquatic environment. Because the fishes and the lower aquatic organisms are all cold-blooded, metabolism in these organisms is largely dependent upon temperature. Therefore, in the aquatic environment temperature and dissolved oxygen must be considered together. As temperature rises to the upper levels of normal temperatures, the dissolved oxygen must be near to or at saturation in order to insure full activity. Temperature influences aquatic life in a number of ways. It may be lethal, it may initiate or prevent migration, and it triggers or retards spawning activities. It controls to a certain extent the metabolism, activity, feeding and growth of organisms. It is important in the governing of productivity. It is very important in determining the qualitative and quantitative makeup of the aquatic biota. Even small changes in temperature can make the environment more favorable for one species and less favorable for another with the result one species decreases while another becomes dominant. Temperature influences the digestion of food and certain enzymatic and physiological processes.

During geological time, the organisms present in a given region gradually adapted to the environmental conditions in that region or perished. In time therefore, the environmental conditions to which these organisms have adapted have now become their environmental requirements. Sudden or large changes in the environmental conditions due to man's activities can be very destructive to the aquatic biota. Aquatic organisms have become adapted to seasonal temperature patterns which are essential for their physiological activities and those of the organisms on which they depend as food. Aquatic organisms have also adapted to daily fluctuations in temperature which in some instances are quite wide. In the setting of temperature standards, attention must be paid to maintaining daily and seasonal patterns of temperature fluctuation. Excessive warming of the water during the winter, early spring or late fall months can have disastrous effects from the standpoint of spawning, emergence or food production. While aquatic organisms

Dr. C. M. Tarzwell

may resist high temperature for short periods, a cooling off at night is essential. They cannot withstand high temperatures around the clock. Daily variations must, therefore, be maintained. When heat is added artificially to the environment, it should be added at a constant rate so that it is superimposed on natural temperatures and the normal daily and seasonal variations are maintained.

Increasing water temperatures is equivalent to moving the whole stream further south. Observations of the aquatic environment over a number of years have led us to the conclusion that certain rises in temperature may be allowed. However, in selecting the allowable increases in temperature, it must be kept in mind that these increases must not be harmful under those conditions during which the rises of temperature are most significant; i.e., during low water flows in the summer months. In determining safe conditions, we must deal with extremes as it is the extremes which are governing and are most important in determining adverse effects. Thus, allowable increases in temperature are governed by the increase which is not significantly harmful during the time of peak temperatures and the low flow and during

Dr. C. M. Tarzwell

winter months when low temperatures are required. In order that this temperature increase may be as large as possible without significant harm, it is essential to definitely limit its duration and to determine its effects during periods when temperature may become critical.

For freshwaters, the National Technical Advisory Committee judged that an amount of heat may be added which will raise the average minimum daily low flow for the month 5°F; except daily maximum temperatures shall not exceed the maximum allowable temperature for the locally desired biota. With this suggested approach, the amount of heat expressed as BTU's which could be added to any stream during any given month would be determined as follows: The average of daily low flows for the month in question when expressed in pounds of water is multiplied by the allowed increase in temperature in degrees Fahrenheit, namely 5. By the addition of this constant amount of heat in BTU's per second on existing temperatures, we will automatically obtain temperatures which follow the normal seasonal and daily temperature fluctuations characteristic of that stream.

Dr. C. M. Tarzwell

Peak allowable temperatures for certain fish associations for both summer and winter have been listed in the National Technical Advisory Committee Report on Water Quality Criteria.

As has been indicated previously, high allowable temperatures must be of only short duration. Temperatures which adult fish can withstand for short periods are entirely unsatisfactory for long-term exposures. Further, temperatures which may be resisted by adults for considerable periods can be entirely unsatisfactory for the survival of the species. When fish and other aquatic organisms are subjected to the stress of high temperatures, they require periods of cooler water such as naturally occur at night. High temperatures must not be maintained around the clock.

Seasonal variations are also of outstanding importance. There must be a gradual acclimatization to summer and winter temperatures, with a gradual warming up in the spring and a gradual cooling off in the fall. Temperatures which would be normal and favorable in the summer would be rapidly lethal under winter conditions; conversely, temperatures which would be entirely favorable in the winter season would be rapidly lethal after the fish have become acclimated to the higher summer temperatures. In most of the warm water fishes, spawning is induced by a rising temperature and an increasing day length. If temperatures are artificially raised before the increase in day length, harmful effects can occur. The food of many fishes, or their young, consists of phytoplankton or those organisms that directly feed on phytoplankton. Since the phytoplankton development is influenced by the length of day as well as temperature, with artificial temperature rises, it is possible to have the young produced before their customary food is available. The same principle applies to the emergence of aquatic insects. The higher temperatures may speed up their life process such that they emerge into a cold and uninviting climate.

An allowable artificial temperature increase of 10°F in those streams having natural temperatures which range from the mid to upper eighties during July and August can have very harmful effects even though a maximum temperature of 93°F is imposed. This is because with an increase of 10°F the minimum daily temperatures become

Dr. C. M. Tarzwell

93°F or more and if cooling towers are used to just meet the maximum allowable, temperatures at or near 93°F will be maintained around the clock. Such prolonged high temperatures have been demonstrated to be harmful to many fishes.

A study of temperature records of some Iowa streams for March, April, May and June indicates that temperatures range in the 40's and 50's during March and April and even into May, but the range in May is usually in the upper 40's and in the 50's. In June, temperatures are more stable and in the 60's and above. A rise of 10°F will push temperatures normally in the 40's and 50's into the 50's and 60's with resultant damage to the black bass reproduction. A rise of 10°F will lengthen the summer season and may result in a change in the biota.

- - -

MR. BLOMGREN: Since our report was prepared, Mr. Chairman, and transmitted to the Iowa Pollution Control Commission, we have done some additional analysis on bacterial loadings to the Missouri River. We have a young engineer in our office, Bob Hegg, who will paraphrase and discuss the material in Appendix H which we transmitted to the Commission by Air Mail Special last weekend and we have made a distribution to the staff members of the Iowa Water Pollution Control Commission.

MR. STEIN: All right, we will accept that.

MR. SAMSON: Mr. Blomgren, will that be an Appendix to the Water Quality Standards Conference for the State of Iowa?

MR. BLOMGREN: Yes, Mr. Samson, we have a supply of the appendix out in the hall.

MR. STEIN: They will be distributed.

(Appendix H appears herein at pages 245-B to 253.)

STATEMENT BY BOB A. HEGG
SANITARY ENGINEER, MISSOURI BASIN REGION
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
KANSAS CITY, MISSOURI

MR. HEGG: Mr. Chairman, my name is Bob Hegg. I am a Sanitary Engineer with the Missouri Basin Region of the Federal Water Pollution Control Administration.

An analysis was made on the eight-day dry weather navigation flow data, which is presented in tables in this appendix. This data is taken from the October 1968 survey conducted by the FWPCA. The effort of this analysis was directed at determining the effect of treatment on removing the bacterial contamination in the Missouri River.

The coliform data on the Missouri River from Gavins Point to St. Joseph were evaluated in terms of a coliform mass. For example, the data were evaluated from a total number per day approach rather than a concentration approach. The coliform masses were calculated for the various sources along the reach of the Missouri River from Gavins Point to St. Joseph. These coliform source data included measurements of the waste effluents at the Sioux City Sewage Treatment Plant, the Council Bluffs Sewage Treatment Plant, the Monroe Street Sewer at Omaha, Nebraska, and estimates of the densities in the remaining outfalls from Omaha and Papillion Creek. Also included were the measurements of coliform densities from the major tributaries.

A mass diagram of this data is presented in the appendix. The mass diagram indicated that the major sources of coliforms in the Missouri River during the dry weather period of the October survey were contributed by the major cities. The coliform contribution to the Missouri River from the Big Sioux River, the Soldier River, and the Boyer River was negligible during the normal flow period of the October survey. These observations led to the next portion of the analysis.

The major source of coliforms are from the wastewater effluents. Consequently, an analysis was made to determine the effect of treatment on reducing the quantity of coliforms in the Missouri River. A 93 percent reduction of coliform was assumed with secondary treatment and a 98.5 percent reduction of coliform was assumed with secondary treatment and chlorination. The estimated effects of these types of treatment on river coliform concentrations are also shown in a graph in the appendix.

Other analyses were made also. A mass balance was also made on the fecal coliform organisms. The results showed that approximately 50 percent of the fecal coliforms in the river could be accounted for in the reach from Sioux City to Omaha. This includes only those fecal coliforms measured at the Sioux City Sewage Treatment Plant. It does not include coliform organisms that may have been contributed from the other waste sources in the Sioux City area. Greater than 75 percent of the fecal coliform organisms could be accounted for in the reach of the river from Omaha to St. Joseph.

The effect of two stage chlorination was also evaluated. It was assumed that with two stage chlorination, a concentration of 500 MPN/100 ml could be attained in effluent. This reduction is far in excess of the 98.5 percent reduction assumed for secondary treatment with chlorination. This effluent concentration would virtually eliminate the effect of the major cities on the river coliform concentration. If this reduction were realized, the major sources of bacterial contamination would have been the Boyer River and the Platte River. This conclusion is based on conditions existing in the river that were similar to those in the October 1968 survey conducted by the FWPCA. The maximum value of coliform concentration in the river, assuming two stage chlorination and primary treatment, was estimated to be 4250 MPN/100 ml.

The following conclusions are based on the above analyses and apply to the Missouri River conditions that existed during the dry weather period of the October 1968 survey.

1. Greater than 85 percent of the total coliforms measured in the Missouri River were contributed by the major waste sources along the stream.

2. Approximately 50 percent of the fecal coliforms measured in the Missouri River-

were contributed by the major waste sources that were measured during the October 1968 survey.

3. The total and fecal coliform contribution to the Missouri River from the Big Sioux River, the Soldier River and the Boyer River were negligible during the dry weather period of the October survey.

4. Secondary treatment alone would not be adequate to provide reduction of coliforms to meet the National Technical Advisory Committee's standard for public drinking water supplies based on the analysis outlined above. And that standard is 10,000 MPN/100 ml.

5. Chlorination following secondary treatment would be adequate to provide reduction of coliforms to meet the National Technical Advisory Committee's standard for public water supplies based on this analysis.

6. Primary treatment with two stage chlorination would be adequate to provide reduction of coliforms to meet the National

Technical Advisory Committee standard for public water supplies also based on this analysis.

Thank you.

MR. SAMSON: Mr. Stein, I would ask you, on this analysis made on the eight-day dry weather period, was there any correlation by the Federal Government on this analysis with either the authorities in Nebraska or Iowa?

MR. STEIN: Can you answer that, Mr. Hegg?

MR. SAMSON: I am asking you that as Chairman, was any correlation on this work as set out here in the--

MR. STEIN: What do you mean by correlation?

MR. SAMSON: Did they correlate work with the State authorities on this investigation?

MR. STEIN: Do you mean is this a cooperative study?

MR. SAMSON: Yes.

MR. STEIN: Again you are going to have to ask the technical staff. I am not any more familiar with this than you are.

Mr. Hegg or anyone?

MR. HEGG: I can't answer that.

MR. BLOMGREN: You weren't running any concurrent studies of that nature, were you, Mr. Schliekelman?

MR. SCHLIEKELMAN: No.

MR. BLOMGREN: This was data collected by the Federal Water Pollution Control Administration.

MR. RADEMACHER: Both States were invited to cooperate with us on this.

MR. BLOMGREN: Certainly. They participated in the survey from the standpoint of--

MR. STEIN: Let me try to get this question. Mr. Samson of Nebraska asked a question. As I understand it, your answer was yes?

MR. RADEMACHER: Yes.

MR. STEIN: All right.

DR. MORRIS: Mr. Stein.

MR. STEIN: Yes.

DR. MORRIS: I am Dr. Morris from the Iowa Water Pollution Commission.

I did visit the installation which

included the mobile laboratory for chemical work and the bacteriological work on the upper part of the river. I visited out here in October and again in January. So I saw the operation, discussed what was going on, but we had no data collection process going from the State of Iowa, at least.

MR. SAMSON: Thank you.

Thanks, Mr. Stein.

MR. STEIN: Thank you.

Mr. Blomgren, do you have any more?

MR. BLOMGREN: This next statement is addressed to the "Chairman, Water Quality Standards Conference, State of Iowa, Convening April 15, 1969, Council Bluffs, Iowa.

"Dear sir:

"The Missouri River Public Water Supplies Association represents all of the major public water utilities using the Missouri River as a source of supply, except Kansas City, Kansas. This statement is the collective judgment of the utilities comprising the association.

"The Missouri River Public Water Supplies

Association is concerned that the present Missouri River raw water quality does not further deteriorate and that the Missouri River shall remain a suitable and desired source of drinking water for the 3,000,000 to 4,000,000 persons supplied by the utilities of the association.

"The water treatment plants of the Association's members are designed and operated to produce a quality water for drinking and other uses, from the present normal quality Missouri River water. If the Missouri River water quality is additionally polluted, existing water treatment may no longer be adequate for the production of a quality drinking water. Taste and odor, disinfection and coagulation problems which have already occurred at all of the water treatment plants on the Missouri River because of ammonia, oil and fertilizer spills into the Missouri River, and because of unusual runoffs from agricultural lands, clearly show that there is a definite limit to the amount of pollution which can be removed in existing water treatment plants.

"The Missouri River Public Water Supplies Association supports the FWPCA statement to the Water Quality Standards Conference - State of Iowa, convening

April 15, 1969, at Council Bluffs, Iowa, in all matters which can be demonstrated to result in Missouri River water quality improvement."

This letter is signed "Very truly yours, H. O. Hartung, President, Missouri River Public Water Supplies Association."

I ask that that be placed in the record, Mr. Chairman.

MR. STEIN: It has been when you read it in the record.

MR. BLOMGREN: That is the copy in the transcript.

(Which said letter is as follows:)

County Water

ST. LOUIS COUNTY WATER CO. • 8390 Delmar Blvd. • University City, Mo. 63124 (314) 991-3404

Chairman
Water Quality Standards Conference
State of Iowa, Convening April 15, 1969
Council Bluffs, Iowa

Dear Sir:

The Missouri River Public Water Supplies Association represents all of the major public water utilities using the Missouri River as a source of supply, except Kansas City, Kansas. This statement is the collective judgment of the utilities comprising the Association.

The Missouri River Public Water Supplies Association is concerned that the present Missouri River raw water quality does not further deteriorate and that the Missouri River shall remain a suitable and desired source of drinking water for the 3,000,000 to 4,000,000 persons supplied by the utilities of the Association.

The water treatment plants of the Association's members are designed and operated to produce a quality water for drinking and other uses, from the present normal quality Missouri River water. If the Missouri River water quality is additionally polluted, existing water treatment may no longer be adequate for the production of a quality drinking water. Taste and odor, disinfection and coagulation problems which have already occurred at all of the water treatment plants on the Missouri River because of ammonia, oil and fertilizer spills into the Missouri River, and because of unusual run-offs from agricultural lands, clearly show that there is a definite limit to the amount of pollution which can be removed in existing water treatment plants.

The Missouri River Public Water Supplies Association supports the FWPCA statement to the Water Quality Standards Conference - State of Iowa, convening April 15, 1969, at Council Bluffs, Iowa, in all matters which can be demonstrated to result in Missouri River water quality improvement.

Very truly yours,

HOHartung

H. O. Hartung, President
Missouri River Public Water
Supplies Association

HOH:rb

C. V. Blomgren

MR. BLOMGREN: Mr. Chairman, as our conclusions in this matter, we again site the water uses detailed in our report, the need for quality criteria to support those uses and the necessary changes in Iowa's water quality standards to achieve conformance with the Federal Water Pollution Control Act. The following recommendations are made for addition to the Iowa water quality standards to insure that we fulfill our legal responsibilities. These recommendations are consistent with those items contained in the Secretary's conference notice and are based on the best information available at this time. I will repeat the three major recommendations in total for the benefit of those not present at the Davenport session on April 8th.

The three which I mentioned in my summary statement, radiological, phenol and non-degradation, I believe have been resolved by your counterstatement there, at least there was some measure of agreement, and it would serve no purpose for me to repeat those recommendations.

Recommendation No. 1. All significant municipal wastes discharged into the interstate waters of Iowa shall receive a minimum of secondary treatment prior to discharge.

MR. SAMSON: What page are you on there, Carl?

MR. BLOMGREN: Page VI-1, Mr. Samson.

MR. SAMSON: Thank you.

MR. BLOMGREN: All significant industrial wastes shall receive an equivalent of secondary treatment prior to discharge into any interstate stream. For the Missouri River, a timetable of compliance shall be submitted no later than December 31, 1969. In no case shall the compliance date be any later than December 31, 1977.

Recommendation No. 2. Control of bacteriological pollution by continuous disinfection shall be implemented. A timetable for implementation shall be established by September 30, 1969. In no case shall the compliance date for the installation and operation of continuous disinfection facilities extend beyond December 31, 1970.

No. 3. For the production and well being of locally occurring desirable stream fish populations, heat additions should be limited as follows.

At no time shall the addition of heat be authorized which will raise the water temperature more than 5 degrees Fahrenheit; but in any event the addition of heat shall not raise water temperatures above a maximum tailored for each individual lake or stream and necessary to protect the production of locally occurring desirable fish populations and their associated biota.

That completes the Federal Water Pollution Control Administration presentation.

MR. STEIN: Let me just ask a question here for clarification.

You say that all significant municipal wastes discharged into the interstate waters of Iowa shall receive a minimum of secondary treatment prior to discharge, all significant industrial wastes receive an equivalent to secondary treatment prior to discharge into any interstate stream. Then the next sentence says, "For the Missouri River" and talks about a timetable to be completed not later than December 31, 1969, compliance December 31, 1977.

The question I have is the interstate rivers, as I read it in the call of the conference, go beyond the Missouri River? Do you mean this timetable to include those streams or just those discharging to the Missouri River?

MR. BLOMGREN: In our summary statement, Mr. Chairman, we recognize that Iowa has designated secondary treatment for those interstate streams tributary to the Missouri and established a timetable which will secure this secondary treatment for all those wastes prior to July 31, 1972.

Is that correct, Mr. Buckmaster?

MR. BUCKMASTER: I am Robert Buckmaster, Chairman of the Iowa Water Pollution Control Commission.

Let me just clarify one thing. The dates are not wrong, but you have assumed at Davenport and you have assumed here something which is erroneous.

We have never required secondary treatment as such on the interior streams. What we have required is whatever treatment is necessary to maintain the water quality standards, and there isn't an interior stream in the State, because of the volume of flow, that doesn't require secondary treatment in order to meet those standards.

But you misstate our position when you

state that we require secondary treatment. We require whatever it takes, as we do also on the interstate streams.

MR. STEIN: Yes. I think his point is well taken. All I am doing is trying to clarify this and make the issue.

MR. BUCKMASTER: Yes.

MR. STEIN: I don't want anything to fall within the cracks, so to speak.

The point is, if you mean to say that we can strike that phrase "for the Missouri River" and if this is your recommendation that we should have a timetable of compliance to meet these dates for all the internal streams--for all the interstate streams, do you mean that?

MR. RADEMACHER: No, sir, just the Missouri River.

MR. STEIN: How about those other rivers? What do you mean for them?

MR. RADEMACHER: It again refers, sir, to the charge of the Secretary in terms of what was to be considered. This is the Missouri River that we are talking about in setting this particular standard.

MR. STEIN: No, no, no, no, no.

Let me stay with this. This is not a question of argument. This is a question of trying to join the issues so we know what the situation is.

Let me say in all candor, I think I understand Mr. Buckmaster's position. I am not sure that the position of the Federal people, as I find it now, joins with it and makes the issue.

The point is you have asked for secondary treatment on the Missouri River in this case, a timetable of compliance to be submitted no later than December 31, 1969. In no case shall the compliance date be any later than December 31, 1977.

I can understand your position on that, I can understand Mr. Buckmaster's position on that.

MR. SAMSON: Mr. Chairman--

MR. STEIN: Just a moment, Mr. Samson.

Now let's come to the streams, the interstate streams in the notice, which have been covered by the Secretary's call. As I understand it, Mr. Buckmaster says his State's position is they do not require secondary treatment or any other necessary form of treatment except what is required by the facts of the case. As I understand it, in here, since we say "for the Missouri River," the Federal Government is not making any recommendations for a timetable or a degree of treatment for the wastes in those streams. Is that the way? This is the way this reads to me.

MR. BUCKMASTER: You are referring to the interior streams here?

MR. STEIN: Yes.

MR. BUCKMASTER: But interstate?

MR. STEIN: But which the Secretary calls interstate.

Now, if it is your judgment that we are supposed to have secondary treatment for those streams, then we have an issue joined. But the difficulty is I don't get a Federal recommendation on those streams.

The point is, to say that you agree with what Iowa has done on these streams, I am not sure you and I are saying the same thing. Therefore, I think we have to really zero in on this.

Do you mean that for all the interstate streams covered you want secondary treatment?

MR. RADEMACHER: Mr. Stein, I think that the approval of the standards for the State of Iowa, with the exceptions cited, the three conditions that were set, and I will repeat them: The treatment requirements and implementation plan for waste discharges to the Missouri and Mississippi Rivers; 2, the requirements for disinfection of all discharges which may be sources of bacteriological pollution; and 3, the temperature criteria for the interstate waters of the State other than the Missouri and Mississippi Rivers.

I will defer to Mr. Burd to comment about the approval of standards for the interior streams, the interstate waters.

MR. STEIN: Do you want to answer that, Bob?

You see, I want to be sure--this is not an argument here--but I want to be sure that the Federal people and Iowa understand each other and you are saying the same thing. In other words, we can't come back and say--I guess we can come back if we want to, but I think it would be a fruitless thing to come back and say we haven't understood each other on the interior streams of the State, that we meant one thing and Iowa meant another when we were together. As far as I can see, I am not sure we mean the same thing.

MR. BUCKMASTER: I will state it again and make sure if they have any argument about it.

Our position is basically no different on the Mississippi and Missouri than it is on the interstate streams that feed these streams or, for that matter, on our interstate streams ourselves. We apply the same policy to all of them. I am just citing from memory, but I believe this is accurate.

Out of almost 500 treatment plants, and I am not differentiating between intra and interstate waters, but of almost 500 plants on the interior of Iowa there are four or five that we have determined or may determine do not require secondary treatment to meet the water quality standards. These are small cities, in the area, as I recall, of two or three hundred, most of them. But our tests and our philosophy are the same all the way through. We require whatever treatment it takes to meet the water quality standards, and in roughly 500 interior treatment plants there may be four or five in small cities that we would not require secondary treatment of because in our judgment it wasn't necessary to maintain the water quality standards.

MR. STEIN: Thank you.

MR. BUCKMASTER: Does that explain our position?

MR. STEIN: I think I understand your position. What I want to know is if the Federal Government wants to make a recommendation on that, are they satisfied with that position, or whether we have an issue.

MR. BURD: My name is Bob Burd, Deputy Assistant Commissioner for--

FROM THE FLOOR: We can't hear him.

MR. STEIN: Come up here. I do think this is a key question that we can zero in on now because it might give us a lot of trouble later.

STATEMENT BY ROBERT BURD
DEPUTY ASSISTANT COMMISSIONER FOR
OPERATIONS, FEDERAL WATER POLLUTION CONTROL

MR. BURD: My name is Bob Burd, Deputy Assistant Commissioner for Operations, FWPCA.

The Secretary of the Interior approved the standards for the interior interstate streams of Iowa, that is those streams other than the Missouri and Mississippi Rivers, with the exception of the temperature criteria and the bacteriological criteria. He did approve the implementation plan which relates to waste treatment requirements and time schedules.

The recommendation that FWPCA is making at this time is that all significant wastes discharged into the Missouri River shall receive a minimum of secondary treatment prior to discharge. All significant industrial wastes will receive an equivalent of secondary treatment prior to discharge into the Missouri River.

So when we talk about treatment requirements and the recommendation, we are talking about discharging to the Missouri River.

MR. BUCKMASTER: That is my understanding of the posture of both of us, with one exception. I thought we had agreed on disinfection because of the letter you sent me and I didn't think that was any longer an argument either.

But other than that I agree with you.

MR. STEIN: Edward Lightfoot, Missouri Water Pollution Control Board.

Mr. Lightfoot.

STATEMENT BY EDWARD LIGHTFOOT
ON BEHALF OF JACK K. SMITH, EXECUTIVE SECRETARY
MISSOURI WATER POLLUTION BOARD

MR. LIGHTFOOT: My name is Edward Lightfoot and I am presenting this statement on behalf of Mr. Jack K. Smith, Executive Secretary of the Missouri Water Pollution Board.

Staff members of the Missouri Water Pollution Board have reviewed the "Water Quality Standards Conference, State of Iowa," a document published by the U. S. Department of the Interior, Federal Water Pollution

Control Administration, Missouri Basin Region. We offer the following comments:

The interstate waters common to Missouri and Iowa of concern to Missouri at this hearing are the Missouri River, Nishnabotna River, Tarkio River, Nodaway River, Platte River, West Tarkio River, One Hundred and Two River, Grand River, East Fork of the Grand River, Thompson River, Little River, Weldon River, and the Chariton River. We have attached a table of the established water uses in Missouri for waters of these streams.

The Missouri Water Pollution Board submitted a statement in letter form at the original water quality hearing held at Council Bluffs, December 2, 1966; at Ottumwa on December 5, 1966; and at Muscatine on December 6, 1966. Then on December 16, 1966, the Missouri Water Pollution Board submitted an attachment which pointed out the minor differences between Missouri and Iowa criteria.

The recommendation for secondary treatment and disinfection are effluent regulations, a part of the plan for implementation. We are concerned that the quality of the interstate waters from Iowa does not interfere with the legitimate water uses established for waters in Missouri, not the degree of treatment to be provided.

Temperature requirements in Missouri interstate waters is a maximum of 90 degrees Fahrenheit with a maximum of 5 degrees Fahrenheit cross sectional change. We now have data available indicating that the water temperature of the shallow, flat north Missouri streams approaches the ambient air temperature. High temperature measured in the north Missouri streams to date is 97 degrees Fahrenheit. On other occasions the temperature had exceeded the 90 degrees Fahrenheit in our standards. We have attached water quality data collected to date on the Iowa-Missouri interstate streams in the Missouri River Basin.

Recommendations for phenol concentration in Iowa's streams is proposed at one microgram per liter. Missouri, in cooperation with Illinois, has collected one grab sample per month from the Mississippi River at Canton, Quincy, and other downstream water plant intakes over the past five years. Concentrations of phenol or phenolic like compounds have been measured at Canton from 0 to 50 micrograms per liter. From July 1964, to June 1968, 15 out of 46 samples measured 2 micrograms per liter to 50 micrograms per liter with a medium value of 7 micrograms per liter and an average value of 11.4 micrograms per liter.

No taste or odor problems have been associated with these concentrations of phenol or phenolic-like compounds in the Canton water supply or the downstream water supplies on the Mississippi River. Furthermore, we do not know of any taste and odor problems due to phenolic compounds at Missouri cities using the Missouri River as a water supply.

We have been informed by Dr. Louis Hemphill, University of Missouri, Sanitary Engineering Department, that "The quantitative specificity of the present standard methods 4-Aminoantipyrine is insufficient to determine the specific nature of phenolic materials. Experimental laboratory work has shown that this test has high quantitative response for phenol and enolic materials. However, the nature of phenol and creosol ortho, meta and para isomers gives a confused value."

Therefore we do not believe that one

microgram per liter is a realistic value for the criteria. If a taste and/or odor problem occurs in a water supply, we will take necessary steps to identify the source and to correct the problem regardless of the measured concentration of phenols.

(The following tables were submitted by Mr. Lightfoot:)

II. WATER USES
TABLE 2
MISSOURI RIVER

Name of stream	Future Present	Irrigation	Livestock watering	Propagation of commercial fish	Propagation of warm water sport fish	Propagation of cold water sport fish	Wildlife watering	Industrial cooling water	Industrial process water	Drinking water supply	Hydroelectric power	Boating and canoeing	Fishing	Whole body water contact recreation	Aesthetic value	Receive effluents	Navigation	Receive surface runoff
MISSOURI RIVER																		
Missouri River	P	X	X	X			X	X	X	X		X	X		X	X	X	X
	F	X	X	X			X	X	X	X		X	X		X	X	X	X
	P																	
	F																	
	P																	
	F																	
	P																	
	F																	
	P																	
	F																	
	P																	
	F																	
	P																	
	F																	
	P																	
	F																	
	P																	
	F																	
	P																	
	F																	
	P																	
	F																	
	P																	
	F																	

Future uses not herein specified are not expressively excluded, however, such future uses are not anticipated.

II. WATER USES

TABLE 3

LOWER MISSOURI RIVER BASIN

Interstate Streams

Name of stream	Future Present	Irrigation	Livestock watering	Propagation of commercial fish	Propagation of warm water sport fish	Propagation of cold water sport fish	Wildlife watering	Industrial cooling water	Industrial process water	Drinking water supply	Hydroelectric power	Boating and canoeing	Fishing	Whole body water contact recreation	Aesthetic value	Receive effluents	Navigation	Receive surface runoff
NISHNABOTNA RIVER																		
Nishnabotna River	P	X	X		X		X						X		X			X
	F	X	X		X		X						X		X			X
TARKIO RIVER																		
Tarkio River	P	X	X		X		X						X		X	X		X
	F	X	X		X		X			X			X		X	X		X
West Tarkio River	P	X	X		X		X						X		X			X
	F	X	X		X		X			X			X		X			X
NODAWAY RIVER																		
Nodaway River	P	X	X		X		X					X	X		X	X		X
	F	X	X		X		X			X		X	X		X	X		X
PLATTE RIVER																		
Platte River	P	X	X		X		X						X		X	X		X
	F	X	X		X		X			X			X		X	X		X
One Hundred and Two River	P	X	X		X		X			X			X		X	X		X
	F	X	X		X		X			X			X		X	X		X
	P																	
	F																	

The future use of the Tarkio, West Tarkio, Nodaway, and Platte Rivers for drinking water supply is the only future use listed above which is not also a present use of these streams. It is necessary to set aside now the future use of these waters for drinking water supplies so that the water quality will be suitable when the need for additional supplies of water arises. It is not possible at this time to estimate when the Tarkio, West Tarkio, Nodaway and Platte Rivers will be used for public water supply; however, it is clear that public water supply would be a logical future use of these streams.

Future uses not herein specified are not expressively excluded; however, such future uses are not anticipated.

TABLE 5
LOW FLOW CHARACTERISTICS
FOR
GRAND-CHARITON RIVER BASIN
Interstate Streams

Stream--------------------------Location	Annual 7 day low flow, in cubic feet per second, for indicated recurrence interval in years.				
	2	5	10	20	30
GRAND RIVER					
Grand River near Grant City	1.7	-----	[e]0-1	-----	-----
Grand River near Stanberry	3.3	-----	[e]0-1	-----	-----
Grand River near Darlington	8.2	-----	[e]1-3	-----	-----
Grand River near Pattonsburg	11	-----	[e]1-3	-----	-----
Grand River near Gallatin	20	6	3.6	2.7	2.4
Grand River at Chillicothe	78	-----	17	-----	-----
Grand River near Sumner	105	41	25	17	13
EAST FORK OF GRAND RIVER					
East Fork Grand River at Albany	1.9	-----	[e]0-1	-----	-----
THOMPSON RIVER					
Thompson River near Mt. Moriah[f]	11	-----	d	-----	-----
Thompson River at Trenton	16	5.4	3.2	2.0	1.6
LITTLE RIVER					
The U.S. Geological Survey has insufficient flow data for the Little Rive on which to base a flow analysis.					

d-Insufficient data for estimate

e-Range in discharge estimated on basis of frequency curve slopes at nearby continuous-record stations and extension of regression curves

f-Short-time continuous-record station which was analyzed as a partial-record station due to scant data

TABLE 5
LOW FLOW CHARACTERISTICS
FOR
GRAND-CHARITON RIVER BASIN (continued)
Interstate Streams

Stream--------------------------Location	Annual 7 day low flow, in cubic feet per second, for indicated recurrence interval in years.				
	2	5	10	20	30
WELDON RIVER					
Weldon River near Mercer[b]	0.3	0	0	0	0
Weldon River at Mill Grove	2.2	0.3	0	0	0
Weldon River near Trenton	6.2	-----	(d)	-----	-----
CHARITON RIVER					
Chariton River at Novinger	7.4	2.1	1.0	0.5	0.3
Chariton River near Prairie Hill	21	9.5	6.5	5.0	4.6

b-Discontinued continuous-record station
d-Insufficient data for estimate

WATER QUALITY MONITORING STATION

STATION NO. - C-100 RIVER MILE - 100 BASIN - Chariton River

STREAM - Chariton River Location - At Livonia, Missouri

DATE	FLOW CFS	TURBIDITY J.C. UNITS	WATER TEMP. °C	pH	CARBONATE ALKALINITY as $CaCO_3$ (ppm)	BICARBONATE ALKALINITY as $CaCO_3$ (ppm)	DISSOLVED OXYGEN (ppm)	PHOSPHATE ORTHO as PO_4 (ppm)	TOTAL PHOSPHATE	AMMONIA as N (ppm)	NITRATE as N (ppm)	SULFATE as SO_4 (ppm)	IRON (ppm)	SPECIFIC CONDUCTANCE IN MICROMHOS	CA HARDNESS as $CaCO_3$ (ppm)	MG HARDNESS as $CaCO_3$ (ppm)	COLIFORM BACTERIA per 100 ml.	FECAL STREP. BACTERIA per 100 ml.
1- 6-66	750	430	3	7.7	0	76	12.4	0.5	---	0.9	1.5	----	---	225	145	98	200	6,000
7-19-66	16.9	100	31	8.1	0	190	8.6	0.3	---	0.8	0.1	70	1.1	475	180	79	90	50
4- 3-67	12,500	1,000	14	7.4	0	74	6.8	1.6	1.8	4.1	0.3	96	15	290	90	41	20,000	4,200
5- 7-68	1,120	310	16	7.4	0	68	8.6	1.3	2.0	1.2	1.8	60	4.1	250	78	41	2,600	170
10- 9-68	7.6	120	15	8.6	12	174	11.0	0.3	0.6	1.0	<0.1	130	0.5	600	161	92	600	120

WATER QUALITY MONITORING STATION

STATION NO. GM-29 RIVER MILE: 29 BASIN: Grand River

STREAM: Medicine Creek LOCATION: West of Unionville

DATE	FLOW CFS	TURBIDITY J.C. UNITS	WATER TEMP. °C	pH	CARBONATE ALKALINITY as $CaCO_3$ (ppm)	BICARBONATE ALKALINITY as $CaCO_3$ (ppm)	DISSOLVED OXYGEN (ppm)	PHOSPHATE ortho as PO_4 (ppm)	TOTAL PHOSPHATE	AMMONIA as N (ppm)	NITRATE as N (ppm)	SULFATE as SO_4 (ppm)	IRON (ppm)	SPECIFIC CONDUCTANCE IN MICROMHOS	CA HARDNESS as $CaCO_3$ (ppm)	MG HARDNESS as $CaCO_3$ (ppm)	COLIFORM BACTERIA per 100 ml	FECAL STREP. BACTERIA per 100 ml
3-27-67	114	800	13	7.6	0	90	8.4	2.2	5.2	2.0	1.8	78	15	450	98	45	11,000	3,800
5-20-68	7.77	270	14	7.8	0	146	9.2	0.6	1.0	0.8	0.6	54	2.5	405	146	54	1,900	570
10-9-68	7.93	250	14	8.0	0	136	7.2	0.4	1.1	1.0	<0.1	22	0.6	300	108	65	3,100	1,400

WATER QUALITY MONITORING STATION

STATION NO. GW-28 RIVER MILE: 28 BASIN: Grand River

STREAM: Weldon LOCATION: West of Princeton

DATE	FLOW CFS	TURBIDITY J.C. UNITS	WATER TEMP. °C	pH	CARBONATE ALKALINITY as $CaCO_3$ (ppm)	BICARBONATE ALKALINITY as $CaCO_3$ (ppm)	DISSOLVED OXYGEN (ppm)	PHOSPHATE ortho as PO_4 (ppm)	TOTAL PHOSPHATE	AMMONIA as N (ppm)	NITRATE as N (ppm)	SULFATE as SO_4 (ppm)	IRON (ppm)	SPECIFIC CONDUCTANCE IN MICROMHOS	CA HARDNESS as $CaCO_3$ (ppm)	MG HARDNESS as $CaCO_3$ (ppm)	COLIFORM BACTERIA per 100 ml	FECAL STREP. BACTERIA per 100 ml
1-6-66	28.8	40	.5	8.1	0	171	14.1	0.3	---	0.9	2.0	---	---	400	162	63	<10	610
7-19-66	57.3	2000	29	7.5	0	87	5.8	2.2	---	1.2	0.2	48	19	200	88	61	>1000	17000
3-27-67	177	900	15	7.8	0	116	9.2	1.1	1.8	2.7	1.2	84	14.0	425	147	53	10000	3700
5-20-68	31.6	6	17	8.1	0	236	10.8	0.3	0.7	0.7	<0.1	62	0.3	550	225	81	40	40
10-9-68	157	2000	14	8.1	0	104	7.7	2.0	2.6	1.4	0.9	30	0.7	265	98	59	52000	37000

WATER QUALITY MONITORING STATION

STATION NO. GT-52 RIVER MILE: 52 BASIN: Grand River

STREAM: Thompson River LOCATION: Northeast of Bethany

DATE	FLOW CFS	TURBIDITY J.C. UNITS	WATER TEMP. oC	pH	CARBONATE ALKALINITY as $CaCO_3$ (ppm)	BICARBONATE ALKALINITY as $CaCO_3$ (ppm)	DISSOLVED OXYGEN (ppm)	PHOSPHATE ortho as PO_4 (ppm)	TOTAL PHOSPHATE	AMMONIA as N (ppm)	NITRATE as N (ppm)	SULFATE as SO_4 (ppm)	IRON (ppm)	SPECIFIC CONDUCTANCE IN MICROMHOS	CA HARDNESS as $CaCO_3$ (ppm)	MG HARDNESS as $CaCO_3$ (ppm)	COLIFORM BACTERIA per 100 ml	FECAL STREP. BACTERIA per 100 ml
1-5-66	649	950	4	8.1	0	114	13.6	0.6	---	0.35	2.0	---	---	275	117	48	<10	8,300
7-19-66	123	320	28	7.9	0	135	7.0	0.6	---	0.7	0.2	48	4.2	300	120	39	1,900	120
3-28-67	546	1,500	14	7.8	0	151	9.6	2.0	4.6	1.3	0.8	68	20	425	153	47	6,000	1,700
5-20-68	59.9	15	19	8.3	2	186	10	0.3	0.9	0.6	<0.1	48	0.3	460	173	58	70	<10
10-9-68	76.5	1,000	14	7.6	0	104	8.2	1.5	2.0	1.3	0.7	54	0.8	250	94	57	52,000	41,000

WATER QUALITY MONITORING STATION

STATION No. GL-83 RIVER MILE: 83 BASIN: Grand River

STREAM: Locust Creek LOCATION: West of Unionville

DATE	FLOW CFS	TURBIDITY J.C. UNITS	WATER TEMP. °C	pH	CARBONATE ALKALINITY as $CaCO_3$ (ppm)	BICARBONATE ALKALINITY as $CaCO_3$ (ppm)	DISSOLVED OXYGEN (ppm)	PHOSPHATE ortho as PO_4 (ppm)	TOTAL PHOSPHATE	AMMONIA as N (ppm)	NITRATE as N (ppm)	SULFATE as SO_4 (ppm)	IRON (ppm)	SPECIFIC CONDUCTANCE IN MICROMHOS	CA HARDNESS as $CaCO_3$ (ppm)	MG HARDNESS as $CaCO_3$ (ppm)	COLIFORM BACTERIA per 100 ml	FECAL STREP. BACTERIA per 100 ml
3-27-67	49.7	800	13	7.4	0	71	9.2	1.1	1.8	2.0	2.0	96	13	380	122	45	1,700	5,800
5-20-68	5.19	190	18	7.8	0	146	9.2	0.5	1.0	0.8	0.6	60	1.4	420	162	46	490	260
10-9-68	.596	32	15	8.1	0	174	8.5	0.1	0.4	1.1	<0.1	48	0.5	380	133	69	1,300	12,000

WATER QUALITY MONITORING STATION

STATION NO. EFG-31 RIVER MILE: 31 BASIN: Grand River

STREAM: E.F. of Grand LOCATION: Northeast of Grant City

DATE	FLOW CFS	TURBIDITY J.C. UNITS	WATER TEMP. °C	pH	CARBONATE ALKALINITY as $CaCO_3$ (ppm)	BICARBONATE ALKALINITY as $CaCO_3$ (ppm)	DISSOLVED OXYGEN (ppm)	PHOSPHATE ortho as PO_4 (ppm)	TOTAL PHOSPHATE	AMMONIA as N (ppm)	NITRATE as N (ppm)	SULFATE as SO_4 (ppm)	IRON (ppm)	SPECIFIC CONDUCTANCE IN MICROMHOS	CA HARDNESS as $CaCO_3$ (ppm)	MG HARDNESS as $CaCO_3$ (ppm)	COLIFORM BACTERIA per 100 ml	FECAL STREP. BACTERIA per 100 ml
1-5-66	48.7	280	3	8.1	0	137	13.8	0.4	---	0.5	0.7	---	---	300	125	50	230	4,600
7-18-66	6.89	180	26	7.7	0	144	7.0	0.3	---	0.8	<0.1	54	2.4	300	124	43	1,500	2,200
3-28-67	31	470	13	7.7	0	143	9.6	0.8	6.4	1.6	1.2	70	10	425	149	55	800	400
5-20-68	3.86	160	18	7.9	0	160	9.4	0.5	1.0	0.8	0.7	50	1.1	400	150	60	90	440
10-9-68	15.4	650	15	8.1	0	122	7.8	0.7	1.0	1.0	0.1	20	0.5	290	116	49	55,000	49,000

WATER QUALITY MONITORING STATION

STATION NO. W.F.G. 170 RIVER MILE: 170 BASIN: Grand River

STREAM: W. F. of Grand River LOCATION: West of Grant City

DATE	FLOW CFS	TURBIDITY J.C. UNITS	WATER TEMP. °C	pH	CARBONATE ALKALINITY as $CaCO_3$ (ppm)	BICARBONATE ALKALINITY as $CaCO_3$ (ppm)	DISSOLVED OXYGEN (ppm)	PHOSPHATE ortho as PO_4 (ppm)	TOTAL PHOSPHATE	AMMONIA as N (ppm)	NITRATE as N (ppm)	SULFATE as SO_4 (ppm)	IRON (ppm)	SPECIFIC CONDUCTANCE IN MICROMHOS	CA HARDNESS as $CaCO_3$ (ppm)	MG HARDNESS as $CaCO_3$ (ppm)	COLIFORM BACTERIA per 100 ml	FECAL STREP. BACTERIA per 100 ml
1-5-66	115	300	3.0	8.1	0	144	13.8	0.6	---	0.35	1.4	---	---	325	128	52	20	410
7-19-66	37.4	2000	26	7.5	0	129	5.6	3.5	---	1.4	0.2	62	7.5	300	131	49	>1,000	41,000
3-28-67	48.6	390	15	8.0	0	139	9.0	0.9	2.3	3.2	1.6	64	6.2	400	147	41	5,600	2,300
5-21-68	9.70	24	12	8.1	0	174	10	0.5	0.8	0.8	<0.1	48	0.5	460	171	64	1,200	170
10-8-68	19.9	2000	14	7.8	0	106	7.6	3.3	4.0	2.5	0.8	64	0.7	295	100	53	54,000	140,000

WATER QUALITY MONITORING STATION

STATION NO. - P136 RIVER MILE: 136 BASIN: Platte River

STREAM - Platte River LOCATION: East of Sheridan

DATE	FLOW CFS	TURBIDITY J.C. UNITS	WATER TEMP. °C	pH	CARBONATE ALKALINITY as $CaCO_3$ (ppm)	BICARBONATE ALKALINITY as $CaCO_3$ (ppm)	DISSOLVED OXYGEN (ppm)	PHOSPHATE ortho as PO_4 (ppm)	TOTAL PHOSPHATE	AMMONIA as N (ppm)	NITRATE as N (ppm)	SULFATE as SO_4 (ppm)	IRON (ppm)	SPECIFIC CONDUCTANCE IN MICROMHOS	CA HARDNESS as $CaCO_3$ (ppm)	MG HARDNESS as $CaCO_3$ (ppm)	COLIFORM BACTERIA per 100 ml	FECAL STREP. BACTERIA per 100 ml
3-28-67	82.1	975	14	7.6	0	105	8.4	2.0	2.0	1.7	2.0	72	---	380	106	55	24,000	9700
5-21-68	13.8	120	15	8.1	0	150	8.6	3.0	3.2	0.7	1.0	42	4.0	400	126	62	4,600	750
10-8-68	6.76	33	14	8.0	0	156	7.5	0.6	1.0	1.1	0.3	74	0.7	400	118	74	2,300	130

WATER QUALITY MONITORING STATION

STATION NO. - P102 RIVER MILE 73-76 BASIN Platte

STREAM - 102 River LOCATION: At Hopkins

DATE	FLOW CFS	TURBIDITY J.C. UNITS	WATER TEMP. °C	pH	CARBONATE ALKALINITY as $CaCO_3$ (ppm)	BICARBONATE ALKALINITY as $CaCO_3$ (ppm)	DISSOLVED OXYGEN (ppm)	PHOSPHATE ortho as PO_4 (ppm)	TOTAL PHOSPHATE	AMMONIA as N (ppm)	NITRATE as N (ppm)	SULFATE as SO_4 (ppm)	IRON (ppm)	SPECIFIC CONDUCTANCE IN MICROMHOS	CA HARDNESS as $CaCO_3$ (ppm)	MG HARDNESS as $CaCO_3$ (ppm)	COLIFORM BACTERIA per 100 ml.	FECAL STREP. BACTERIA per 100 ml.
1-5-66	59.4	190	1.0°	8.1	0	143	13.9	1.1	-----	0.8	1.8	-----	---	300	120	60	4700	1370
7-18-66	5.95	270	34°	7.6	0	67	6.0	1.1	-----	0.8	0.2	50	3.4	170	51	43	270	110
3-28-67	14.9	1000	16°	7.9	0	153	9.0	1.6	1.8	1.7	1.8	66	---	400	118	57	6000	3900
5-21-68	0.8	95	16°	8.4	2	152	10.8	1.6	2.5	0.5	0.3	42	0.6	380	126	70	280	350
10-8-68	2.74	100	15°	8.1	0	166	7.8	0.5	0.8	0.9	<0.1	48	0.5	410	133	73	3300	4000

WATER QUALITY MONITORING STATION

STATION NO. - 60 RIVER MILE: 60 BASIN: Nodaway River

STREAM: Nodaway LOCATION: West of Burlington Junction

DATE	FLOW CFS	TURBIDITY J.C. UNITS	WATER TEMP. °C	pH	CARBONATE ALKALINITY as $CaCO_3$ (ppm)	BICARBONATE ALKALINITY as $CaCO_3$ (ppm)	DISSOLVED OXYGEN (ppm)	PHOSPHATE ortho as PO_4 (ppm)	TOTAL PHOSPHATE	AMMONIA as N (ppm)	NITRATE as N (ppm)	SULFATE as SO_4 (ppm)	IRON (ppm)	SPECIFIC CONDUCTANCE IN MICROMHOS	CA HARDNESS as $CaCO_3$ (ppm)	MG HARDNESS as $CaCO_3$ (ppm)	COLIFORM BACTERIA per 100 ml	FECAL STREP. BACTERIA per 100 ml
1-5-66	793	550	1°	8.0	0	124	15.5	0.6	----	0.55	1.6	------	---	250	115	63	<10	11,800
7-18-66	216	450	35°	7.8	0	106	6.6	1.2	----	0.8	<0.1	48	4.5	450	92	55	----	------
3-28-67	356	1300	16°	7.7	0	109	7.8	3.0	----	2.6	1.6	54	15	330	114	43	28,000	7,500
8-23-67	---	15	22°	8.6	10	240	8.4	---	0.73		.023	40	0.03	478	160	70	----	------
9-20-67	---	15	21°	8.3	4	210	7.0	---	0.65		.16	36	0.02	426	135	61	----	------
10-19-67	---	10	13°	8.5	12	208	10.0	---	0.42		.0	38	0.12	463	153	61	----	------
11-8-67	---	7	4°	7.6	0	230	12.5	---	.40	.00	.045	36	0.16	454	150	66	----	------
3-12-68	---	9	6°	8.8	14	184	13.0	---	.30	.06	.023	33	.05	382	128	49	----	------
4-10-68	---	5	20°	8.6	12	212	11.1	---	.38	.02	.86	34	.02	452	150	61	----	------
5-8-68	62	6	13°	8.6	12	204	9.2	---	.63	.05	.25	44	.00	462	168	57	----	------
5-21-68	48.5	29	19°	8.6	6	176	11.0	1.3	2.5	0.9	0.5	42	0.4	420	148	74	140	160
6-19-68	---	0	23°	8.5	8	228	8.0	---	.70	.10	.18	33	.05	460	155	61	----	------
7-10-68	---	11	25°	8.6	10	228	8.5	---	.60	.08	.0	30	.05	458	153	65	----	------
8-7-68	---	322	28°	7.7	0	88	6.1	---	.50	.10	.99	14	.90	183	58	20	----	-------
9-18-68	---	24	15°	8.7	18	184	9.8	---	1.0	.00	.068	28	.05	417	135	58	----	------
10-8-68	324	2000	15°	8.1	0	120	5.9	5.5	6.4	1.8	2.0	40	0.7	320	84	59	>1000	14,000
10-16-68	27.1	17	17°	8.5	8	216	8.1	---	.81	.05	.045	31	.14	407	143	62	----	------

WATER QUALITY MONITORING STATION

STATION NO. T13 RIVER MILE: 13 BASIN: Tarkio

STREAM: Tarkio LOCATION: West of Fairfax

DATE	FLOW CFS	TURBIDITY J.C. UNITS	WATER TEMP. °C	pH	CARBONATE ALKALINITY as $CaCO_3$ (ppm)	BICARBONATE ALKALINITY as $CaCO_3$ (ppm)	DISSOLVED OXYGEN (ppm)	PHOSPHATE ortho as PO_4 (ppm)	TOTAL PHOSPHATE	AMMONIA as N (ppm)	NITRATE as N (ppm)	SULFATE as SO_4 (ppm)	IRON (ppm)	SPECIFIC CONDUCTANCE IN MICROMHOS	CA HARDNESS as $CaCO_3$ (ppm)	MG HARDNESS as $CaCO_3$ (ppm)	COLIFORM BACTERIA per 100 ml	FECAL STREP. BACTERIA per 100 ml
1-4-66	113	440	2	8.0	0	156	13.8	0.6	---	0.45	1.6	----	----	325	130	58	1,100	7,400
7-18-66	31.7	290	36	8.0	0	127	6.2	1.1	---	0.8	<0.1	44	3.6	300	110	53	30	340
3-28-67	50	140	20	7.9	0	183	7.2	0.9	2.3	3.7	---	58	3.9.	425	151	51	3,800	1,400
8-22-67	---	8	30	---	22	195	11.2	---	.77	---	.0	28	.02	434	123	69	----	----
9-19-67	---	20	27	8.9	22	210	10.2	---	.30	---	.023	32	.02	479	142	70	----	----
10-20-67	---	40	7	8.6	10	230	9.9	---	.59	---	.27	36	.12	492	152	66	----	----
11-7-67	---	40	6	8.5	14	240	13.0	---	.43	.00	.09	34	.04	496	150	74	----	----
3-12-68	---	11	6	8.7	16	204	13.6	---	.22	.08	.023	32	.10	476	135	61	----	----
4-10-68	---	2.0	22	8.7	20	232	12.8	2.8	4.2	2.4	.225	38	.01	626	138	73	----	----
5-8-68	24	17	21	8.7	16	222	9.7	.87	1.6	.08	.045	33	.08	490	132	66	----	----
5-21-68	13.8	180	22	8.4	4	200	8.8	1.6	2.7	1.4	0.7	40	0.9	500	163	62	170	230
6-19-68	----	4	29	8.6	14	252	10.0	---	.62	.05	.203	38	.02	550	158	69	----	----
7-10-68	----	15	31	8.5	8	256	9.2	---	.09	.16	.023	58	.04	611	130	90	----	----
8-7-68	----	7.7	32	8.8	20	214	12.1	---	.68	.00	.5	30	.38	495	123	73	----	----
9-18-68	----	25	14	8.1	0	224	6.9	---	1.1	.42	.18	63	.06	583	125	70	----	----
10-16-68	----	25	16	8.1	0	256	6.2	---	1.1	.26	.18	60	.20	635	135	78	----	----

WATER QUALITY MONITORING STATION

STATION NO. N-8 RIVER MILE: 8 BASIN: Nishnabotna

STREAM: Nishnabotna LOCATION: Near Hamburg, Iowa

DATE	FLOW CFS	TURBIDITY J.C. UNITS	WATER TEMP. °C	pH	CARBONATE ALKALINITY as $CaCO_3$ (ppm)	BICARBONATE ALKALINITY as $CaCO_3$ (ppm)	DISSOLVED OXYGEN (ppm)	PHOSPHATE ortho as PO_4 (ppm)	TOTAL PHOSPHATE	AMMONIA as N (ppm)	NITRATE as N (ppm)	SULFATE as SO_4 (ppm)	IRON (ppm)	SPECIFIC CONDUCTANCE IN MICROMHOS	CA HARDNESS as $CaCO_3$ (ppm)	MG HARDNESS as $CaCO_3$ (ppm)	COLIFORM BACTERIA per 100 ml	FECAL STREP. BACTERIA per 100 ml
1-4-66	1,240	850	2	8.1	0	213	14.6	0.7	----	.50	1.6	----	---	400	175	87	6,000	15,000
7-18-66	791	800	33	7.5	0	139	5.2	2.2	----	0.8	0.2	54	7.0	375	139	71	1,200	3,800

MR. LIGHTFOOT: Thank you.

MR. STEIN: Thank you.

Let me indicate what we may have on the program for the rest of the day.

By the way, does anyone from Nebraska want to speak or not?

If not--

MR. SAMSON: Mr. Chairman, I have indicated that I didn't have any remarks to make, and I am accompanied here by our Executive Secretary, Mr. Filipi, who I know loves to make a speech.

But I am somewhat confused, which isn't unusual. In your Water Quality Standards Conference, State of Iowa, you made a requirement here or a recommendation that all significant municipal wastes discharged into the interstate waters of Iowa shall receive a minimum of secondary treatment prior to discharge, and then you have a timetable there that compliance shall be submitted not later than December 31, 1969, and the compliance date of not later than December 31, 1977.

Now, if my memory serves me correctly,

and you can correct me if I am wrong, I think there is a provision in the Federal Act that requires some consistency between areas. Isn't there some provision like that?

MR. STEIN: I don't know about it.

MR. SAMSON: I thought that there was some, generally areas that were neighbors, that there should be some consistency.

MR. STEIN: I think we try to be consistent. Of course we are from the east, and you know Emerson was from the east too and he is the man who said,"Consistency is the hobgoblin of mediocre minds."

(Laughter.)

MR. SAMSON: Well, aside from that, our provisions in Nebraska, the water quality standards which were approved by the Secretary of the Interior sometime ago, in connection with the Missouri River provides that;

The date for compliance with the standards on all municipal and industrial wastes, except for those facilities located on the main stem of the Missouri River, shall be by 1972. A special timetable for facilities discharging into the Missouri River will be developed by

December 31, 1969. A continuing program of waste treatment plant construction will go forward with the assistance of the grants.

I wonder if there isn't some inconsistency here on the position of the Federal authorities on what is required here in Iowa and what we have done in Nebraska.

And the second point I wanted to raise is on this continuous disinfection shall be implemented as a control of bacteriological pollution. I don't recall as far as Nebraska was concerned that there was ever any problem raised by you folks on the Federal level involving the control of the bacteriological pollution and we are going to run into this question of continuous disinfection.

MR. STEIN: We will throw all those questions up to our staff. I think you have a point on several of those.

One, let me indicate that as far as I see the standards program, and the staff can check me, dealing with 53 jurisdictions and in dealing with Federal-State relations, I don't think you are going to have complete uniformity or it may depend on your definition of consistency. Every State program is not going to be the same and I don't think the Congress or anyone contemplated if you are going to have 53 different programs that they would be the same.

The point is, I think that they would be compatible. Now, let's get to one step at a time. As I understood the colloquy before between Mr. Buckmaster and Mr. Burd, and without drawing any conclusions I can put this together, I think, in a logical package.

Taking what Mr. Buckmaster said, I think we might say that all significant wastes in the feeder streams to the Missouri are receiving secondary treatment. If the judgment is that these are not significant wastes, then I can see how they could approve a program that didn't have secondary treatment for all. And the difference here may come about as to the degree of treatment required on the discharges directly to the Missouri River. I don't know that we can try to put a program like that together.

Now, we have several other problems. I don't know whether you have a heat requirement in Nebraska either, do you, like this?

MR. SAMSON: You raise an interesting question. We have two atomic-powered plants putting into the

Missouri River, and I think what we worked out on thermal pollution was approved by your agency.

Isn't that right, Mr. Rademacher, on the thermal pollution, that is at Desoto--and if there is such a thing--at Desoto and at Falls City?

MR. RADEMACHER: Again I think that the question of thermal standards on the Missouri River is not an issue. It is on the interior streams of Iowa that this question arises.

MR. BUCKMASTER: I agree.

MR. STEIN: Well, this still raises a question, you see, if you are going to look for consistency. I am not sure that there was any requirement on--is there a thermal requirement on the interior streams in Nebraska?

MR. SAMSON: Will you restate that?

MR. STEIN: Is there a requirement on the thermal pollution? Is it about the same as this that you are recommending here?

MR. BURD: Yes.

MR. STEIN: All right.

MR. BUCKMASTER: What is it?

MR. STEIN: I don't know.

MR. BUCKMASTER: Let's have somebody tell us who does know.

MR. STEIN: Does anyone remember this?

MR. BUCKMASTER: I think it is important that we know because we have spent almost a total day in Davenport and here by people who have been pulled in all over the United States talking about a difference of three degress, and if it didn't require any for Nebraska it would be interesting to Iowa to know why, although we don't claim that would be any defense for us, but it would be an interesting exercise in how the Federal mind works.

(Laughter.)

MR. STEIN: Thank you for a double compliment, that we have a mind and it works.

(Laughter.)

MR. BUCKMASTER: Now show us how, Mr. Stein.

(Laughter.)

MR. STEIN: Well, I think we can produce that, but let's not hold up the proceedings for that.

Let's move on. Can we answer that second question that Mr. Samson raised on disinfection? Do we have a requirement for disinfection in Nebraska?

MR. SAMSON: No.

MR. STEIN: We don't?

MR. SAMSON: None.

MR. STEIN: All right. We don't have a requirement in the internal streams or in the Missouri?

All right.

I suggest we go on and we will give you an opportunity later when we find the temperature, if there is a temperature requirement, to get that information in the record. O. K.?

Let me indicate the people we have left this afternoon.

MR. SAMSON: Mr. Stein, may I inquire, what is the response from the government on that bacteriological disinfection, what is the position of the government?

MR. STEIN: You heard the recommendation here. They said they had none for Nebraska.

MR. SAMSON: I mean inasfar as Iowa is concerned.

MR. STEIN: I think they agree. It says

control--unless I am mistaken--control of bacteriological pollution by continuous disinfection shall be implemented. A timetable for implementation shall be established by September 30, 1969. In no case shall the compliance date for the installation and operation of continuous disinfection facilities extend beyond December 30, 1970.

MR. SAMSON: All right. Thank you.

MR. STEIN: And that is the position as far as I know of the people preparing this report for Iowa. As far as I can see, and check my recollection if this isn't correct, I think the region--this is not the Kansas City region, but the region in Chicago made the same recommendation in Davenport last week or essentially the same recommendation.

What we do have is a list of three more participants this afternoon. One is W. W. Amundson of Sioux City, second is Mrs. Koerber of the League of Women Voters, and the third is Dr. Morris. Is there anyone else? Because we are going to recess before we hear these three.

Is there anyone else who would want to be heard this afternoon? If you do, would you come up to me during recess. We will stand recessed for 10 minutes.

(RECESS)

MR. STEIN: May we reconvene.

May we have Mr. Amundson, please, of Sioux City.

STATEMENT BY WILLIAM AMUNDSON
CITY ENGINEER
SIOUX CITY, IOWA

MR. AMUNDSON: Mr. Chairman and conferees, I am Bill Amundson, City Engineer for Sioux City. I have no written statement. I merely want to reiterate the position of Sioux City in this matter.

I would like, in speaking for Sioux City, to take the position of thanking the Iowa Water Pollution Control Commission for the stand that they have taken in this matter and to indicate that the city of Sioux City is in full agreement with it.

Sioux City, as many of you know, holds the unfavorable and unpopular and dubious distinction of having been one of the few cities put under Federal order to cease and desist polluting the Missouri River prior to the construction of our primary treatment plant. We have constructed this primary treatment plant and we feel that we have probably as tight a rein on our situation and the packing industry in our city as anyone on the river. We deplore the situation that goes on in other areas on the Missouri River, particularly on the other side with our adjacent State Nebraska.

We feel that we wonder whether the measurements that have been taken by the Federal Water Pollution Control Administration were taken specifically from the Sioux City--our name has been bandied around here today as being a serious contributor to this pollution; we wonder whether these measurements were taken as representing Sioux City's outfalls rather than the many, many other outfalls that contribute to the downstream areas just below Sioux City.

I would repeat again that the city of Sioux City takes the stand of supporting the position of the Iowa Water Pollution Control Commission.

MR. STEIN: Thank you, Mr. Amundson.

You know, we were up in Sioux City many

years, and I will say after they got the plant in it was very nice up there because they used to invite me to that annual steak dinner they had in Washington.

Let's go off the record for a minute.

(Off the record.)

MR. STEIN: May we have Mrs. Koerber, of the League of Women Voters.

STATEMENT BY MRS. GEORGE G. KOERBER
DIRECTOR AND STATE CHAIRMAN FOR WATER RESOURCES
LEAGUE OF WOMEN VOTERS OF IOWA

MRS. KOERBER: I am Mrs. George G. Koerber, an elected Director of the League of Women Voters of Iowa and State Chairman for Water Resources. The League of Women Voters is a volunteer, non-partisan group working to promote informed and active participation of citizens in government. I am grateful for this opportunity to present the views of Iowa League members regarding surface water quality standards.

For many years, the League in Iowa and in the United States has been concerned with water resources.

Mrs. G. G. Koerber

We have expressed our concern by supporting measures to encourage coordinated planning and management of water resources on a river basin or regional basis. At the same time, we have worked for enactment and enforcement of pollution abatement legislation as well as for State and Federal appropriations and local bond issues to construct treatment facilities. In 1965, the League with other interested groups supported the formation of the Iowa Water Pollution Control Commission.

We were particularly pleased that the statute establishing the Commission declared that the public policy of Iowa is "to conserve the waters of the State and to protect,maintain, and improve the quality thereof for public water supplies, for the propagation of wildlife, fish and aquatic life, and for domestic, agricultural, industrial, recreational and other legitimate uses of such waters; to provide that no waste be discharged into any waters of the State without first being given the degree of treatment necessary to protect the legitimate uses of such waters; to provide for the prevention, abatement, and control of new, increasing, potential, or existing water pollution." The statute, in addition, specifically empowers the Commission "to develop comprehensive plans and programs for the prevention, control and abatement of new, increasing, potential, or existing pollution of the waters of the State."

Acting under this authority, the Iowa Water Pollution Control Commission has made Iowa a leader in pollution control. Iowa has the highest percentage of its urban population served by sewage treatment facilities. The Commission has proposed regulations to prevent and control water pollution by cattle feedlots. Thus Iowa is among the first group of States to deal constructively with this problem. For providing this leadership, the Commission deserves wider recognition of its achievements than it has received.

In addition, the Commission should be commended for adopting a preventive policy toward water quality standards for low flow streams. This policy is stated on page 8 of the Water Quality Criteria and Plan for Implementation and Enforcement as revised June 1968. It reads "to protect legitimate uses on low flow streams, the wastes will be given the highest practicable degree of treatment without respect to dilution in order to prevent the development of nuisance or health problems below discharge. Treatment less than secondary treatment will not be accepted unless it can be shown that the legitimate uses can be protected with a lesser degree of treatment."

Now, if this means what I think it means, I ask these questions: If it is possible to require secondary treatment on low flow streams without proof by the Commission that water quality has been affected adversely, is it not possible to require the same degree of treatment on high flow streams as well? Is it not equally valid to place the burden of proof that primary treatment is not detrimental on those discharging into high flow streams as well as those on low flow ones? After all, a high flow has at least one disadvantage--even though it provides greater dilution, it has the effect of decreasing the distance between communities so that the stream has less time between communities to cleanse itself.

The League of Women Voters of Iowa believes secondary treatment or its equivalent by municipalities and industries along the Missouri River is necessary to prevent and control new, increasing, or potential pollution, if not existing pollution. We ask the Iowa Water Pollution Control Commission to continue to look ahead, to anticipate problems and to adopt measures to prevent the development of nuisance or health problems.

With our present population, let's assume for a moment that primary treatment is adequate, what happens if we wait to require secondary treatment? Even with the best monitoring system possible, water quality would be lowered unless we can install treatment facilities on an overnight basis.

We urge the Iowa Water Pollution Control Commission to adopt a requirement for secondary treatment or its equivalent along the Missouri River and to initiate plans for implementation and enforcement now. Action now will prevent pollution from accompanying the predicted increase in population for the urban areas along this river, because action now means the necessary treatment facilities will be in operation when the increase occurs--not five or more years later. Action now will save the public money. It costs less to treat the wastes entering the river than it does to treat the water to make it potable or usable by industry. Action now will avoid some of the annual increase in cost of constructing facilities.

On the remaining matters under discussion here, the League as a lay group cannot speak on the technical points involved. We can, however, speak to the policy that will govern the technical decisions. The League believes the Commission when setting quality standards should abide by policy which gives greater weight to protecting the public and to protecting the environment than to other factors.

We know that other areas of the Nation have greater pollution problems. This fact, however, does not remove the need to prevent or control pollution in this basin. On the contrary, the severe problems elsewhere should be justification for preventive action here because it demonstrates so well the result of procrastination and undue reliance upon dilution as a means of water quality control. We must learn from experience and take this opportunity to keep history from being repeated. As taxpayers and consumers, League members are willing to pay their share of the cost to conserve water quality for succeeding generations.

Thank you.

MR. STEIN: Thank you, Mrs. Koerber.

I will put this in next because it comes from an official State agency.

"This telegram is to emphasize the concern of the Missouri Department of Conservation regarding the detrimental effects of pollution on the fish, wildlife, and recreation resources of the Missouri River and its tributaries. We believe that a high degree of waste treatment is necessary to improve the condition of the Missouri River and that a non-degradation policy is essential to prevent further damage to the aquatic resources of waste, heat or other pollutants unforeseen at this time.

"Sincerely,

"Carl R. Noren, Director

"Missouri Department of Conservation."

Now, Mr. Bob Russell.

Mr. Russell.

STATEMENT BY ROBERT C. RUSSELL
EXECUTIVE SECRETARY, IOWA DIVISION
IZAAK WALTON LEAGUE OF AMERICA
IOWA CITY, IOWA

MR. RUSSELL: Mr. Chairman, as Chairman of this conference, we thank you for allowing us to present the following. My name is Robert C. Russell, and I am the Executive Secretary for the Iowa Division of The Izaak Walton League of America (I.W.L.A.). As such, and having received a copy of the March 5, 1969, notice by Secretary of the Interior Walter J. Hickel setting this conference, I brought it to the attention of the Iowa Division I.W.L.A. State Board of Directors at their meeting of March 15, 1969. After discussing the content of the notice and how it related to our interest in water pollution abatement, I was delegated to prepare and present a statement that would contain the sentiments of the Board's discussion and other pertinent commentary. The following is that statement.

It has been the policy and indeed the

history of the Iowa Division of the I.W.L.A. to have a strong interest in and to support a strong water pollution abatement program. Our effort and support in the establishment of the present Iowa Water Pollution Control Law; our statements presented at the November-December,1966, hearings on water quality criteria for all Iowa waters; and our statement given at the four April,1968,public hearings on the subject of cattle feedlot waste disposal all bear this out.

Because of these involvements and our knowledge of the program and actions of the Iowa Water Pollution Control Commission, we would be remiss at this time if we did not publicly thank them for the work that they have done. It should also be noted that many of their accomplishments have been made to date in spite of inadequate financing, lack of departmental personnel, and perhaps even the very Iowa laws under which they administer and operate.

Now to grips with the purpose of this conference, as we understand it: Namely, resolving the differences between the water quality standards of the State of Iowa and the Federal Water Pollution Control

Administration regarding the interstate waters of Iowa, as noted in the conference notice and determined in part not to be consistent with the protection of the public health and welfare, the enhancement of the quality of the water, and the purposes of the Federal Water Pollution Control Act with particular reference to:

1. The treatment requirements and implementation plan for waste discharges to the Mississippi and Missouri Rivers;

2. The requirements for disinfection of controllable waste discharges which may be sources of bacteriological pollution;

3. The temperature criteria for the interstate waters of the State other than the Mississippi and Missouri Rivers.

First it is important to point out that our views on these points are from a non-technical standpoint and to note that we believe the following to be relevant to this conference:

1. From the FEDERAL WATER POLLUTION CONTROL ACT, AS AMENDED, "DECLARATION OF POLICY, Section 1. (a) The purpose of this Act is to

enhance the quality and value of our water resources and to establish a national policy for the prevention, control and abatement of water pollution."

2. From the IOWA WATER POLLUTION CONTROL LAW, CHAPTER 455B.1, Statement of policy, excerpt, "...it is hereby declared to be the public policy of this State to conserve the waters of the State and to protect, maintain and improve the quality thereof..."

3. From the CONSERVATION POLICIES OF THE IZAAK WALTON LEAGUE OF AMERICA in the section on WATER POLLUTION, No. 6. "Since water courses know no political boundaries, pollution control is rightfully a Federal as well as a local, State, and interstate responsibility. Although control measures should be initiated at the lowest effective level, the Federal Government should have clear authority to strongly enforce pollution abatement and prevention in cases when lower

authority proves ineffectual or inadequate."

If these stated Federal and State policies of water quality enhancement and improvement are to have any meaning, for the reasons which this conference was called, and because this organization historically has supported an enhancing clean waters program, we urge the Iowa Water Pollution Control Commission to resolve the issues upon which this conference was called and thereby qualify the Iowa Water Quality Standards with a program acceptable to the Federal Water Pollution Control Administration.

Should the Iowa Water Pollution Control Commission feel the need for changes or additional Iowa legislation that affects its ability to comply with the Federal Water Pollution Control Act, it is suggested that they immediately petition the Iowa Legislature for such authority.

In closing we would like to note the splendid example set by the city of Dubuque, Iowa, in its recent move to improve its sewage treatment program. Perhaps their action will set a pattern for other cities on Iowa's border streams. It could hopefully be indicative that cities, industries and agriculture are seeing the "light" towards a better environment. It is also hoped that the Federal and State water pollution control agencies involved with this conference can show a good example of cooperation.

Thank you.

MR. STEIN: Thank you, Mr. Russell.

Now, before we call on Dr. Morris, is there anyone else from other than the Iowa official agencies who wishes to make a statement?

Yes, come on up here, please.

MR. BEAM: Did you want me to follow Doctor?

MR. STEIN: No. Come on up here.

STATEMENT OF D. F. BEAM
VICE CHAIRMAN, NEBRASKA COMMITTEE FOR PURE AIR AND WATER, INC., OMAHA, NEBRASKA

MR. BEAM: I am Mr. Beam and I am from Nebraska, from Omaha. I am Vice Chairman of the Nebraska Committee for Pure Air and Water, Inc. We, too, thank the Secretary of the Interior and Mr. Stein as his representative for having this regional hearing. I do not have a prepared statement except that I jotted down some notes from attending the meeting this morning.

It seemed to me that the concern seems to be on aquatic life in the streams, and my thought and my question was because we are humans perhaps maybe I missed the point of the whole study, but I think that part of it was brought out when food processing was mentioned, and so forth, when foods are prepared from this water after it is treated. But if we are concerned about the fish life, I think the Federal Government as well as the Iowa Water Pollution Commission needs to be concerned about such matters as toxicity as far as the human being is concerned and I think that the public hearing is threshing out some of the solutions and controls. I think to report back to the public, the taxpayer, that is you and I, you also, myself included, I think this needs to be done, because we need to be made aware of how our money is being spent and if it is being spent wisely.

And then also I am wondering about the Commission staffs, if there is enough public representation on these councils. Nebraska, I understand, has a council, Nebraska Water Pollution Council. I am wondering if there is enough representatives. I think there is one representative to represent the public in Iowa, but I am not too sure about Nebraska. That is one of the questions that I noted down.

Now, one of the other things that I didn't have too much time to delve into was the possibility of the recent heavy construction of nuclear powerplants. I think the Federal Government has adequate technical staff to delve into this and I don't know whether the Federal water pollution council has included this in their studies. This would be a radioactive waste byproduct accident, possibly, and this was just recently brought to the attention of the public through the Des Moines Register of this past Sunday which was summarized from the national history publication about the increase in numbers of nuclear powerplants throughout the country.

I think that your publicity that you have received locally is very good. As far as a lay person, I would like to see more publicity ahead of the conference, although maybe this conference was really earmarked for the people that are concerned, such as the water treatment and sanitation engineers.

Is that true, Mr. Stein?

MR. STEIN: No, no, no. Let me interrupt since you have paused. Don't go away; I don't want to cut you off.

These are always delicate issues. I think you have raised some good questions and we are going to let Nebraska, hopefully, answer you. However, I will give you my philosophy on this.

In dealing with publicity before the conference we have certain enforcement actions under the law. One runs the risk of using whatever the forum is--newspapers, radio and T.V.--to try a case or wait until you come before a forum such as this where all sides can be represented. With the best of intentions, when you put all this material out in advance you don't have the traditional face-to-face confrontation that we like in our society, which seems to be the best way of getting at the truth.

We follow the law strictly. First we prepare our reports. I hope they got them out in advance so everyone could see them. We made a distribution to the appropriate congressional members, to the appropriate State agencies, to everyone else we thought would be interested in a technical report. We sent out notices of the conferences, and I like to use the phrase "deadpan notices." I know one mailing from the Kansas City office alone was, what, 800 names, wasn't it? How many names did we get from the Chicago office on the other side? Perhaps a like number.

In other words, we sent out over 1,500 notices. Anyone who received those notices could have come in and asked for the information. The information is all public.

However, as you see, with issues such as we have here--and again trying to have an even-handed administration of the law--I believe that is about as far as an agency can reasonably go before a conference to distribute or disseminate the information and put out what you might call, in quotes, "publicity." The reason for that is apparent. We are trying to set up a forum or a procedure where we have all the points of view and are able to make a judgment. In other words, we wouldn't be calling a conference of this type if we didn't have questions like that and we didn't recognize there might be differing points of view that are to be aired and adjudicated.

I know how much you are interested--and I am just as much--in the widest dissemination of information. But under the American system of government, the jurisprudence, and in the interest of fair play, every governmental agency--I don't care whether it is State, Federal or local--when you have a situation of this type, has to exercise a reasonable amount of restraint in the kind of, again, "publicity" engaged in before the conference. This is the avenue by which we get all the various views, some agreeing, some opposing, so we can try to arrive at truth, if we can, and agreements if at all possible. But this does not mean that we by the use of any term have a closed society or we have any secret information. It is just that we make the information available through normal channels and do not try to push this too far before we have the conference.

By the way, this is the essence of the Federal-State relations. Where a lot of the problems come up--again let me give you my experience--I would say that

70 percent or 80 percent of the problems that I have found in Federal and State relations, Federal-State-local-industrial relations, emanate from someone reading a story or an alleged quote or a release in a newspaper or in a magazine and going back. Again, as you know, they always come to me. I have never felt that I have ever had to tell a magazine or a newspaper to change a story. They do the best they can and we are dealing with very technical matters. By and large, I would say they have been pretty accurate and they generally get the main point of the story across, which is all you can expect. I certainly have never had a complaint.

But this is the kind of thing we all have to watch. I believe we have struck a balance and we come to this as fast as we can. I know the conservation groups and a lot of the public groups would like to see something different, but again I really do not think there is a substitute for face-to-face confrontation.

Feel free to comment on that, or we can ask the Nebraska people to talk first if you want to.

Mr. Samson.

MR. SAMSON: Mr. Beam, I think it is very gratifying that you as a citizen take the time to come over and attend this conference.

I just want to call your attention to our statute in Nebraska provides for a membership of 10, and of those 10 members on the Nebraska Water Pollution Control Council 4 of them are ex officio members of the official bodies in the State House, that is the Director of Fish and Game, Director of Health, Director of Soil and Conservation. And then there are six who were appointed by the Governor, citizens over the State, and they are divided two representing municipalities, I mean citizens such as you and others that the Governor picks out who are interested in water pollution, one represents agriculture and three represent industry. So that is the way the Nebraska Water Pollution Control Council is constituted.

Thank you.

MR. BEAM: Yes, that is very good. That is what I was waiting to hear. I had not seen, you know, a regulation or statute which shows how it is composed. I appreciate that.

I think that is all.

MR. STEIN: Thank you.

Is there anyone else?

If not, may we have Dr. Morris.

STATEMENT BY DR. ROBERT L. MORRIS
ASSOCIATE DIRECTOR, IOWA STATE HYGIENIC LABORATORY, AMES, IOWA

DR. MORRIS: I do not have a prepared paper.

I would like to make a few comments on some of the things that were in the basic initial report from the Federal Government. Some things I do not feel quite represent the feeling of technical people and I would like to point them out. I had planned one of them before this last gentleman talked, but because of his comment I doubly want to discuss it.

I want to talk for a moment about radioactivity. It says in the basic report in the blue cover on V-3, section E under "Radioactivity":

"Water treatment plants remove little radioactive pollution from raw water supply."

Dr. Morris

I hope this isn't true, because at reactor sites we use rather conventional water treatment processes to remove many kinds of radioisotopes. We precipitate and filter them off to concentrate the waste, they are passed through ion exchange materials and the cations, many of them are the isotopes of interest, are taken out in ion exchange and either eluted or taken away from those resins and concentrated in other kinds of fluids so that they can be disposed of in a variety of manners.

And if this statement is true, we are in a very difficult position in handling radioactive wastes. The division of radiological health of the Public Health Service has for many years done very excellent research and given us techniques and procedures to handle these kinds of wastes. They are classical water treatment plant procedures.

Also,the research done by the State Hygiene Laboratory in Iowa has indicated at times following weapon detonations, at least, and this is where our experience has been gained because we really have no industrial radiation industry in Iowa of any size, we have found time and time again in our national rivers, especially the Mississippi, the Iowa and the Cedar, where we have worked primarily, that 50 to 75 percent of the radioactivity in our streams is in suspended material.

Well, the purpose of a water treatment plant in the first step of surface water treatment is to remove suspended material, and many of our plants are highly efficient at this, either in just simple sedimentation or chemically-produced coagulation and then sedimentation, and it is a demonstrated fact that this significantly reduces the concentration of radioisotopes.

If we go through classical lime softening, which is quite common in surface water supplies as well as some ground water supplies in Iowa, these are the materials that are taken out. Strontium, for instance, which is a well-known isotope, reacts to softening processes just like calcium and magnesium and iron and manganese, which are the things we are taking out. So that this again is effective as a removal technique.

I am not going to get complicated and talk about percentage removals and some of the variables

Dr. Morris

in it, but nevertheless I think that statement should be understood.

In Iowa it is not uncommon to zeolite soften municipal supplies. some of them even surface waters. And we know for a fact that radium 226, which is a common natural isotope in ground water supplies in southeastern Iowa, is removed to some place around the 97 to 98 percent removal level by passage through zeolite.

The Public Health Service for about three years had what they called the midwest environmental study based out of our laboratory in Iowa City where hundreds of samples naturally coming from the wells and those which had been passed through zeolite softeners were shown to have reduced this isotope to a very significant extent.

I think because of the comment that this last gentleman made about the concern about reactors, nuclear powerplants, someone should at least comment on this statement.

In addition to the radioisotope idea of removal, I would like to state that our standards, such as existed the last time we considered it, are in essential conformance with what the Water Pollution Control Administration is recommending and I think they are non-controversial and I think they are very adequate. Our research in the Iowa environment during the time when we were getting fallout materials indicated that we never came anywhere near the limit of 1,000 micro-microcuries or picocuries. This is a value that I think we can live with and it is certainly our intent to do what we can from a State level to see that the nuclear installations meet these standards.

So, I don't think there is any reason for concern in this respect. I think the Federal Government requirements or philosophy on this is sound and we have no argument with it.

The second item I would like to discuss a little bit is bacteria. Mr. Buckmaster mentioned that we had a letter from an FWPCA official talking about bacteriological standards and essentially accepting our attitude on this. We feel that in this environment the highest coliform organism density, which is the parameter that practically everyone uses, at least in part, in their evaluation of water quality, is at an extremely high level in the early stages of runoff which reaches or cleanses the upper surface of our soil. Thousands of acres, maybe hundreds of thousands--I have never tried to figure it out--in a broad Statewide rain of a significant amount, in our experience a half inch to an inch normally is sufficient to do this, pollute our streams with agricultural land runoff of which the coliform organism group is a major constituent to a very extensive degree. And after many conferences with the Federal people we finally hammered out an agreement,which we thought was permanent,that we would evaluate the quality of our waters at what was termed low flow.

Now, there are many waters in the State where we can meet the levels which the Federal Government has established and that we have agreed with, and I will only quote one of them for recreation, which seems to be the guiding impetus of these conferences, 200 fecal coliform organisms per 100 milliliters. We can meet this in a geometric mean in many of the recreational waters in Iowa. We can't meet these levels at periods of high flow. We exceed them many, many times and I don't quite see how

Dr. Morris

we can arraign 150,000 farmers from the State of Iowa to change their agricultural practices.

By that I do not mean to infer--and I think the whole Commission agrees with this--that the Iowa Water Pollution Commission is not going to exert every possible effort we can to produce better soil conservation conditions so that the water is held on the individual farm where it falls. What we are really trying to do, and there is some argument against this, but it is the best way we know how to go about it, is to force the water into the ground water aquifer rather than force it into the streams. We are limited to some extent by this because we don't want to have all the water flowing down our streams coming from ground water to a river watershed recharge. We wouldn't have enough to dilute some of the products that get into the river, including effluents from secondary or tertiary treatment. It still needs dilution.

So we are going to try and do what we can to hold the water where it is. Until we do this to an adequate extent, we are only going to meet these standards, or any conceivable bacteriological level, at the low flow periods in our State, and I strongly suspect many of the States in the midwest are in exactly the same position whether they know it or not as yet. If they look, they will see that it is something logical and we don't know how to reverse it except by holding water where it falls.

Actually, the Federal Government survey that was performed, I think in October last year, at least in part brings this out. If you look on page A-2 you can see that the geometric mean below Sioux City was 62,800 total coliforms and 26,600 fecal coliforms, and this was by their description of the hydrology of the period a relatively dry or low flow period.

Over on the top of the next page, A-3, they make a statement that a two-day rain-affected period at 19 of the 21 stations showed the total coliforms at 1.44 million, and the fecal coliforms, which is an important point, were 1.12 million. This is a vast increase, but there is one other salient point here. If you calculate percentages, and I didn't bring my slide rule along and I make all kinds of mistakes with a pencil and paper, fewer with a slide rule, it looks to me like about 77 percent of the total coliforms were fecal in nature, meaning that they came from the intestinal tract of warm-blooded animals. We are quite inadequate to determine whether the fecal coliforms are coming from human beings or from livestock, but we can separate those which are of intestinal origin and, therefore, possible disease transmitters from those which are of natural soil forms which normally have less important effect as far as disease transmission.

So the data which the people from the Federal Government produced here corresponds with what we have found in Iowa on the internal streams, what we have found on the Mississippi, and what we have found with some of the work we have done on the Missouri. And as Mr. Stein so aptly stated, when we get together and talk with each other, we reach some conclusions while we are looking each other in the eye that you don't always bring out in reports that are flown back and forth. This is one of the points. I think we must recognize that we can set any bacteriological standard we want and the environment in this situation doesn't make it possible to meet a number. You have to live with the environmental condition. I think we should understand this about bacteriological levels.

I think there is some question as to whether we can meet this on the Missouri, and anybody who looks at the data which was collected by this study in October has to ask himself this question. To make the decision that you can't meet it is one thing. To decide what you should do about it is another, and there is more than just secondary treatment involved. Disinfection of wastes can reduce the bacteriological load. This gets, in my opinion, to be an engineering decision and an economic one. Which way you want to approach the problem?

The third thing I would like to discuss is phenols. We had a discussion of this in Davenport, and I am not going to spend the time on it here that I did there, except to say that the commonly accepted and agreed to level of phenols pretty much around the country is one part per billion. Again I lean on our environment and the monitoring data which we have and on some theory which I think supports what we find. The State of Missouri made the comment that they can't meet the one part per billion. We can't meet it either. The State of Illinois has signified that they can't meet the one part per billion maximum permissible concentration of phenols in the Mississippi River and other of their internal streams, and the question becomes why.

It is a quite well documented fact that phenolic compounds can result from nature herself. Many natural materials can degrade into phenolic compounds by a variety of pathways, and if people will read the California Water Standards in the section for phenols, this is so stated in here with bibliographies that can be looked up to at least show you where these materials come from.

The best article on this I have read any place in a single spot is an article in Air and Water Pollution Journal, which happens to be a British journal, but it is an extremely well done article. It is entitled, "Recovery and Identification of Organics in Water" by Richard D. Hoak. He was working at the Mellon Institute in Pittsburgh, Pennsylvania. This documents, in my opinion, in a very well done fashion, some of the sources of these materials naturally.

We have noticed the same phenomenon in the phenol problem that we have just been discussing in the bacteriological densities at dry periods and high runoff periods. We find in our work on the streams in Iowa that the phenol concentrations are higher in early stages of runoff. This confirms the fact or at least makes it logical to assume that these are of natural origin, because their increase fits with this kind of a cleansing action on the soil.

Actually, from my own experience and from discussions with the engineers in the State Health Department, we have very little industrial input of phenols into our environment. We are recording quite significant levels in our streams. On the Mississippi we record an average of about 10 parts per billion, we have recorded levels as high as 18. This is the reason why our standard is not one part per billion. It isn't consistent with our environment.

And the other salient point on this, and the reason why the one part per billion was chosen, is that there is a lot of work which shows that certain phenols at the one part per billion level can produce compounds when chlorinated, that do produce measurable tastes. And I am not here to argue with this. It has been done by

Dr. Morris

Schliekelman and myself and Dr. Gakstatter from our staff, discussing proposed sampling points in Iowa, and we worked out, after a full day of going over our data and what the Federal people had, what I believe to be a very adequate surveillance program for Iowa streams. A certain class of surveillance is done quarterly, some things semi-annually, by the way this includes phenols, pesticides, radioactivity, which happen to be monthly, and detergents, which is on a quarterly basis. We sat down and tried to work out with reason and judgment, as engineers and chemists and limnologists, what it would take to evaluate our environment, and we came up with a detailed but variable type program.

The statement goes on in the Missouri River report:

"The sampling frequencies for these parameters should be increased to at least weekly intervals" on a group of streams. Some of these are those on which we have worked out these sampling frequencies.

If I may be permitted a probably prejudiced statement, one which I mean to put politely, I don't know some very competent researchers.

But I think it is reasonable to assume that the types of phenolic compounds that are in our natural environment are not producing the same levels of taste and odor when they are chlorinated in our natural water supplies. Constitutuents entering a molecule can change these taste levels and I think most people working in this field realize this. So that I think we have to take a look at the natural input of phenols into our environment.

There was a discussion of this by the State of Missouri, and I don't recall having heard, and I would like to be informed if it exists, an actual standard for phenols in the State of Missouri. I have heard it stated twice that they concur with our level of 20 parts per billion, but I am not in possession of what level they have actually accepted and, unless I misunderstood the statements, their standards have been approved by the Federal Government. I would like to know whether they are higher than ours or lower than ours.

I also, in my ignorance, do not know what the standards for Nebraska are with respect to phenols.

If it is one part per billion, we are going to have to sample on the other side of the river, I guess, because the part that we sample in Iowa is not going to meet that one part per billion level. I have no information to indicate that the other side of the river is really any better than ours with respect to this type of runoff.

Fourthly, I am deeply disturbed, because it is a responsibility which at least in part would be directed to me and the State Hygienic Laboratory and the Water Pollution Commission and the State Department of Health, over a statement on IV-42 which talks about a matter very dear to my heart, monitoring of water quality, or surveillance, and it says:

"The scheduled sampling frequencies of existing and proposed monitoring stations operated by the Iowa Water Pollution Control Commission are on a quarterly basis for physical, chemical and bacteriological parameters."

Now, I have in front of me a cooperatively worked out agreement or suggestion, I guess, proposal, by the, I think it is, Region V group out of Chicago, a Mr. Risley came to Des Moines and worked with Mr.

Schliekelman and myself and Dr. Gakstatter from our staff, discussing proposed sampling points in Iowa, and we worked out, after a full day of going over our data and what the Federal people had, what I believe to be a very adequate surveillance program for Iowa streams. A certain class of surveillance is done quarterly, some things semi-annually, by the way this includes phenols, pesticides, radioactivity, which happen to be monthly, and detergents, which is on a quarterly basis. We sat down and tried to work out with reason and judgment, as engineers and chemists and limnologists, what it would take to evaluate our environment, and we came up with a detailed but variable type program.

The statement goes on in the Missouri River report:

"The sampling frequencies for these parameters should be increased to at least weekly intervals" on a group of streams. Some of these are those on which we have worked out these sampling frequencies.

If I may be permitted a probably prejudiced statement, one which I mean to put politely, I don't know whether any chemists were involved in making that statement, but there is a whale of a lot of work and a lot of money and an enormous amount of leg work in the field to collect a broad spectrum of samples like this on at least a weekly basis. I can assure you the State Hygienic Laboratory, plus the Health Department in Iowa, doesn't have this kind of manpower muscle, nor do I see where we will get it, nor do I see the necessity for it.

I would like to ask that that statement be looked at again in a little more realistic manner. Some of our streams deserve daily analytical control, others of them weekly, others monthly, some quarterly, and we have tried to work this out.

Now, I was very pleased when Mr. Risley representing the Federal Government, came out and sat down in what I considered to be a very fine technical fashion and worked this program out. I would hope that we would get the same sort of a cooperative attempt from the **Missouri Basin Region**

I want to assure you that we will make available any of the experience our laboratory has and I am sure the Health Department staff will do exactly the same thing, but I don't like to see someone from outside tell us what our sampling frequency should be on an internal stream without at least discussing the problem with us. I can't say whether they have discussed it with the Health Department or not, but they certainly didn't discuss it with me and I am, with tax money and some Federal funds and some State funds with some private funds, footing the bill, and I would like to be consulted when we decide what the monitoring frequency should be. I think that is a reasonable request.

These are basically the things that I wanted to read into the record. Thank you.

I have one other comment. Maybe I shouldn't say this, and Mr. Stein can strike it all from the record if he wants to. I am not ashamed of saying it because I sincerely mean it.

The Iowa Water Pollution Control Commission has had some very sincere and excellent statements of support and understanding from a number of the critical groups in our State. I hesitate to name any of them because I will probably delete some of the important ones. But for myself as one member, I appreciate the understanding that has been shown in the statements from the League of Women Voters, from the Izaak Walton League, and especially because I have been close to some of the conferences that preceded this out-in-the-open statement at both Davenport and Council Bluffs. I think the stand of Iowa industry--and you people can't know this, but I think a lot of you technical people on the Federal level, just as much as those of us on the State level, would be impressed with the sincerity of the large number of industrial people representing many of our big companies, and some of the small ones, in trying to understand their involvement and responsibility in this kind of a program. We have had some statements, although not as many as I think we should have, from the municipalities involved.

And finally, I know I probably shouldn't say this because this is Mr. Buckmaster's forte, but I appreciate the opportunity that Mr. Stein has given us to state our case without closing down on time for people like me who tend to talk too much. I have appreciated the way in which he has operated these conferences. I don't know if anybody else agrees with me or not, but that is the way I feel.

Thank you very much.

MR. STEIN: Thank you.

I have one comment. You had better listen to this, because you may want to strike it yourself. I direct this comment not only to the Iowa people but to the Federal people. Over and over again I have heard in both reports whether we can tell whether a coliform or some kind of pathogen, fecal coli, fecal strep, what-have-you, is coming from field runoff, from a plant, from a packing house, etc.

Now, if my recollection is correct, and I think it is, there are still two people in the room who started on this case on the Missouri River--Virginia Rankin, whose name used to be Hough then, and myself. We were much younger then. Paul Houser is here too. At any rate, as I recall Harold Clark's work during the 1950's, he was subjected to the most piercing cross examination by top notch attorneys who were hired by the packing house plants and municipalities, the attorneys on the staff--some of them have gone up to be judges since then--but I think this was subject to top cross examination. As I understood Mr. Clark's testimony in the late 1950's, it was this:

He could determine whether that bug came from a field runoff or from a waste discharge and could distinguish between them. I believe I recognize another face in the room; I think Mr. Samson was involved as a member of the Hearing Board. Harold Clark could distinguish whether the bug came from a packing house or from human wastes. He also could distinguish by the viability in the length of flow, if he picked it up, say, below Omaha and Council Bluffs, whether it came from Sioux City or from Omaha.

I am not arguing the facts one way or the other. But if we are talking in terms of what kind of treatment exists and where the flow is coming from, it seems to me, gentlemen--and we will check this until tomorrow, although Mr. Geldreich is in the room who works in the same technique--it seems to me, sir, if we had these techniques in the 1950's and they were employed then to give us the information and we have the same questions today, I just wonder why we shouldn't be able to use that methodology, if it is valid, to give us the same results now as we had then. And I just raise that.

May I call Mr. Geldreich for a moment. Is what I said substantially correct?

MR. GELDREICH: That is correct.

MR. STEIN: All right. I would just ask this--

Go ahead.

DR. MORRIS: May I speak to that just a minute?

MR. STEIN: Surely. By the way, it should be clear, I have drawn no conclusions, you know, but it just seems to me that we have a method to get the answers.

DR. MORRIS: I see Mr. Geldreich back there and I know that Mr. Clark, Dr. Kabler, Mr. Geldreich, and a lot of people at the Robert A. Taft Sanitary Engineering Center did an enormous amount of work on this. On the surface of things I too have read and talked with Harold Clark a number of times about this. The only hooker to this system as you described it is that they don't use the standard coliform test in making this differentiation. They go into more sophisticated bacteriology, into the streptococci, and so forth, and these not only can differentiate whether it came from one kind of animal, a cow, a sheep, a pig, but the sad part of it is, unless I read the articles wrong--and I hope Mr. Geldreich will clarify this because I know he was in on it--also these same kinds of organisms have origin in the soil and plants also and this muddies the water, so to speak; so that even with this ability to differentiate above and beyond what the coliforms permit you to do, there have been a lot of scientists--and I think this includes the articles that Clark and Kabler and Geldreich have published--are not absolutely certain in this differentiation. There are breakouts where these organisms are not absolutely identified with that single source.

A lot of bacteriologists have taken rather vigorous exceptions. Now, I don't know about Mr. Geldreich. He may believe very firmly in the differentiation capability. But a lot of people don't quite accept it 100 percent. I am not one of them. I am not as developed in this field, but I have read the articles and there are a lot of people that don't accept that in total.

MR. STEIN: Why don't you--

I defer to Mr. Geldreich.

MR. STEIN: Why don't you come up, Ed.

Here is what I am trying to get at. If this is a crucial issue--and as far as I know, ever since I have been on the Missouri, certainly, and I think on the Mississippi too, but certainly on the Missouri, this is the crucial issue. Let me just give it in the terms that everyone can understand.

Where do the bugs come from? Do they come from human wastes, do they come from a packing house or did they run off from the land? And you may have different effects. And also once you differentiate that, what city do they come from or what industrial outfall do they come from so we can pinpoint the source?

Now, unless we can provide these answers, we are going to find ourselves wallowing around through the years, and I don't care what we do here in the disposition of this, just the equities of the situation are going to require you to have these kinds of answers. I think we will make a great advance if we can agree on the methodology.

Not intending to preempt Ed, I used to

think that Harold Clark had this down to such a fine point that I used to ask him what the sex of the animal was.

(Laughter.)

MR. GELDREICH: Thank you, Mr. Stein.

We have spent about 15 years working on this particular problem, that is finding a better indicator of fecal pollution, and we believe we have it, in fact, I will go so far as to say I know we have it, in the fecal coliform group.

First of all, we have looked at the environment in every aspect, we have looked at warm-blooded animals, be they man or animals other than man. We have looked at the soil, we have looked at fish, we have looked at water, we have looked at plants, we have looked at insects, we have looked at everything that would somehow or other contribute possible pollution to our water environment that we are concerned with and we have concluded and have published in probably about 25 papers and 1 book our findings over this period of time. We believe that the fecal coliform test is measuring the fecal coliforms from all of these animals, be they men or be they some other animals that is warm-blooded. We find these organisms only in the contaminated environment when man or these animals are the contaminators. They are not in soils remote from man's habitation. In fish they are not a normal inhabitant of the intestinal tract, and when fish do have them it is a reflection of the food they eat, the water they swim in.

In plants this is a reflection--and this has been reported by others also besides ourselves--this is a reflection of contamination from fertilizers, from contaminated soil and from insect pollinators. Insect polliners quite frequently spent part of their life cycle in manure piles and other areas where they do pick up the contamination.

The fecal coliform test is in standard methods, it is in the current edition. I am on the methods committee for the next edition, the thirteenth edition, and we have further refined it to put in a fecal coliform membrane filter media in addition to the multiple tubes procedure which is in the current edition. We have the methodologics, they are standardized, they

Dr. Morris

have been recognized in the hearings in Sioux City and Kansas City in the 1950's that we spoke of before.

As far as fecal strep are concerned, this particular indicator does have some room for an improvement in methodology before it is as precise as the fecal coliform procedure. By the way, the fecal coliform procedure will detect 93 percent of all of the fecal coliforms found in warm-blooded animals feces of one sort or another.

The fecal strep in conjunction with the fecal coliform in the development of a relationship or a ratio has been used and we do use it in our stream pollution investigations to pinpoint sources of pollution. We have found repeatedly that in domestic sewage there are more fecal coliforms than there are fecal strep, in the order of a ratio 4 to 1 or higher. In cattle feedlot wastes, slaughterhouse wastes, we find this ratio is reversed from this. There are more fecal streptococci, a tremendously greater number, than there are fecal coliforms and, therefore, our ratio instead of being 4 to 1 is very frequently less than 0.6 to 1. This is the way we can quickly differentiate the two.

Yes, sir.

MR. BUCKMASTER: I am a layman, most of the people here are, and I don't understand it. I think you and Dr. Morris are having fun talking this way.

MR. GELDREICH: Talking shop.

MR. BUCKMASTER: The question is can you distinguish between coliform out of warm-blooded animals and man?

MR. GELDREICH: No, sir.

MR. BUCKMASTER: Well, we are dancing, then, on the head of a pin, because--

MR. GELDREICH: No, let me--

MR. BUCKMASTER: Let me finish. It will take you a couple of minutes. It won't take me a fractio of that time.

MR. GELDREICH: O. K.

MR. BUCKMASTER: Our contention is that the runoff of animal manure from the large number of animals we have, warm-blooded animals, cannot be distinguished from that of a human being. There is no quarrel, I believe, with the question of that that comes from plants and other forms. It is this differentiation between all warm-blooded animals, man being one of them.

MR. GELDREICH: Right.

MR. BUCKMASTER: Can you differentiate between man and cows?

MR. STEIN: Just a moment, please.

MR. BUCKMASTER: Yes.

MR. STEIN: Save the question, because if we go back and forth it gets confused.

I think the answer is that as far as I can understand, although I know he answered no, the answer as I understood they gave me was yes. In other words, if they take the coliform and check, they will be able to tell you if this came from a feedlot or whether this came from a sewage treatment plant by checking the ratio of the fecal coliform--

MR. GELDREICH: Only if we do it in conjunction with a fecal strep test.

MR. BUCKMASTER: We are not talking about a feedlot. We have thousands of acres with cattle and hogs on pasture, so it doesn't come from one source, it comes from individual animals.

MR. STEIN: Yes. Let me rephrase the

question.

When you ask an expert a question, you know, he answers with a question.

You said can you distinguish fecal coliform; the answer is no. What you do is to put the question this way:

Can you take the fecal coliform plus the fecal strep test, do a test on both, put those together and distinguish?

MR. GELDREICH: Very good, that is correct.

MR. STEIN: Then the answer is yes, you see. All right.

MR. GELDREICH: What we are trying to say--

MR. BUCKMASTER: Do you get indication or do you prove it?

MR. GELDREICH: We prove it.

MR. BUCKMASTER: All right, I understand.

MR. STEIN: I am not trying to argue.

MR. BUCKMASTER: I am not either. I was just trying to find out what he is saying.

MR. STEIN: Yes, sir.

MR. BUCKMASTER: We lawyers can finally

work it out, Mr. Stein.

MR. STEIN: Right.

MR. BUCKMASTER: It may be difficult, but we finally get it.

DR. SPEERS: I am Dr. Speers from the State Department of Health.

Let me ask another question now. Supposing you have two sources upstream, one of which is of animal origin and one of which is of human origin. Can you take this ratio then and make any meaning out of it and say from that result that we have two sources, one of human and one of animal origin and how much of each?

MR. GELDREICH: If they are mixed, I assume that somewhere, at this point where you are sampling, both the fecal coliforms from the domestic sewage and the fecal coliforms from the cattle feedlot are mixed in the stream and now we have this mixture, can we sort this out? This becomes somewhat difficult because you get into a ratio which is meaningless in an area between the high one and the low one. It is in these dramatic areas near the runoff and within 24 hours downstream that we can use this material successfully in interpreting.

Beyond that I would not want to venture an answer.

DR. SPEERS: The reason I asked this question, because it seems to me that many of the points of controversy on the Missouri River are exactly this kind of situation where you have got several sources and they are going to be mixed and it is going to be hard to separate.

MR. STEIN: Let me try to get at that.

Just look at the record. I am not trying to draw a conclusion. But when we went up and down the Missouri in the late 1950's with Harold Clark,we in a sense--and I am just talking from a legal evidentiary sense--were lucky that we didn't have these masses of pollution. We had separate sources. In other words, you had a concentration. You know them as well as I do. We had Yankton and Vermillion, then we had Sioux City, then we had Omaha and Council Bluffs, you moved down to St. Joseph, Atchison, Leavenworth, Kansas City, Independence, Columbia, and so forth. And in between those it was relatively clear.

Now, what Harold Clark did was use a third variable, as I recall the testimony, and I think I recall it because it made a tremendous impression on me at that time. What he did was he took the fecal coliform, the fecal strep, used them together in a ratio, and he also took the point of discharge at which he could figure what was coming out from the point of discharge and traced the flow down the river;and he got what to him was a pretty accurate picture of where the bugs came from at all these points down the river.

The thing that I am saying as we are standing here 10 years later is: either we find defects in the method that we can't go along with, or if someone could do this 10 years ago,why can't they do it now? Again,I don't know what the results are going to be if they do it, but this is the issue.

Yes.

DR. MORRIS: I think we do that, Mr. Stein, when we ask to do our bacteriological work, fecal coliforms, at low flow. We essentially are evaluting the input of municipal and industrial wastes, and I know they both exist, in the stream when we have cancelled out a variable. Now, any mathematician knows that one way to simplify the solution to an equation is to cast a variable and that is all we have done, cast a variable.

MR. BUCKMASTER: That is very reasonable.

MR. STEIN: That is right. Again, and as I understood from Mr. Hegg's statement this morning, I understand substantially that this is what they did. Again I have no brief with the figures because that you are going to have to do. They found that 50 percent of the loadings, at least in dry flow, below the big city centers of Omaha and Sioux City came from the municipal waste sources, which included the industries. Now, this is as I understood it and as I understood the thesis--

MR. BUCKMASTER: You are right, you are right, and we have agreed to disinfection of those areas. Our only quarrel comes on the recreational areas other than seasonal. We have no quarrel with this.

MR. STEIN: But what we should do between State and Federal people is that if we have the methodology--and as far as I can sense we do--we should be able to come up with some reasonable statement that all hands can agree on just about how much is coming from the industrial sources; how much is coming out from the municipal sources; how much is coming off the land, and proceed from there.

The only point I am making is--

MR. BUCKMASTER: I don't think we have any quarrel on it.

MR. STEIN: All right, I think this will put us ahead if we have that.

Is there anything else?

MR. GELDREICH: I would like to add one more comment.

Dr. Morris, the fecal strep procedure will be in the next edition of Standard Methods, the one which we used. There are some methods currently used in the book. The methods, as I say, in all cases are available.

DR. MORRIS: We have been using them for years.

MR. GELDREICH: Yes, I know. I have evaluated your laboratory in the past. I know you do it.

Thank you.

MR. STEIN: Let me again make this point. We have a lot of experts in the room here and Dr. Morris and company are familiar with them. I have always pushed for the notion, and I hope Iowa and the other States will

Dr. Morris

join me in this--I think they have in the past--that if any of the bright young people wherever they are located come up with a method and it looks like it is going to work that we use it and we not wait until one of these committees, which gets encrusted like any bureaucracies, including ours, puts it in one of their books and enshrines it in a method book. In other words, if the technique works, we use it as fast as we can.

I think this,what Mr. Geldreich has been talking about is a case in point. As far as I can see, this thing on the fecal coliform has been percolating through their committee for about 10 years now before it has finally made it. I think 10 years is a long time to wait in the pollution business. If you have a method, let's use it for those 10 years and not wait until it gets into Standard Methods.

Does anyone have anything more to say?

With that we will be recessed until 9:30 tomorrow. I think we can finish this tomorrow.

(Whereupon, an adjournment was taken until 9:30 o'clock a.m, April 16, 1969.)

- - -

WEDNESDAY, APRIL 16, 1969

(9:30 a.m.)

MR. STEIN: May we reconvene.

I have here a letter from Roger Bachmann of Ames, Iowa, which we will put in the record.

MR. BUCKMASTER: I didn't hear you, Mr. Stein.

MR. STEIN: This is a letter from Roger Bachmann, which we showed to the technical staff, and there was no objection from either side that this be put into the record.

(Which said letter is as follows:)

April 14, 1969

Mr. Murray Stein
Assistant Commissioner for Enforcement
Federal Water Pollution Control Commission

Dear Mr. Stein,

I would like to enter the following into the proceedings of the Iowa water quality hearings held in Dubuque, Iowa on April 8 and 9, 1969.

On page 15 of the April 1969 statement of the Iowa Water Pollution Control Commission in support of the Iowa water quality standards and plan for implementation and enforcement reference is made to my communication of November 22, 1966 with regard to temperature criteria. This was presented to the public hearing on proposed water quality criteria held by the Iowa Water Pollution Control Commission at Fort Dodge, Iowa on November 30, 1966. Since this statement is being used as a justification for the Iowa temperature criteria, I would like to quote that portion of the communication that dealt with temperature criteria.

"I do not believe that the proposed water temperature criteria will adequately protect aquatic life. While many Iowa fishes may withstand temperatures as high as 95° F for a few days at a time during the summer, the normal temperatures for these species are 10 to 20 degrees lower. Furthermore, many species need periods of cold and seasonal changes in order to complete their life cycles. For more adequate protection of aquatic life I would recommend that water temperatures not be more than 10° F above the normal or upstream temperatures and in no case exceed 95° F."

I would like to point out that the proposed criteria to which I was referring in the above quotation was: "Temperature: Not to exceed 95° F at any time." as listed in the hearing notice of the Iowa Water Pollution Control Commission of 28 October 1966. My main concern at that time was that the proposed criteria allow for a seasonal temperature cycle as well as specifying a maximum temperature. The use of a temperature differential appears to be a practical way to meet this objective and is commonly used in water quality criteria recommendations.

With our present state of knowledge about the complex relationships between stream organisms and water temperature I feel that the choice between a 5° F and a 10° F differential is arbitrary and that I cannot presently provide objective support for either one over the other for the Iowa standards.

Sincerely,

Roger W Bachmann

Roger W. Bachmann, PhD.
R. R. #3
Ames, Iowa

RWB:rh

MR. STEIN: I think it behooves us all to get this record completed as soon as possible. However, I would like anyone here to think about how long he would like to keep the record open if he wants to put in additional material. I would like a suggestion toward the end of this. I would not like to keep this open too long, because the longer we keep the record open the longer the issue is going to be pending and we are not going to be able to come to a conclusion.

We will now continue with Iowa. Mr. Buckmaster.

STATEMENT BY ROBERT BUCKMASTER
CHAIRMAN, IOWA WATER POLLUTION CONTROL
COMMISSION, DES MOINES, IOWA

MR. BUCKMASTER: Mr. Stein, Dr. Morris is not able to be with us today, but he called me this morning and wanted me to put something in the record before we started in response to the colloquy we had at the close yesterday between Mr. Geldreich and Dr. Morris in connection with fecal coliforms.

I make reference now to the report of the Committee on Water Quality Criteria, which was the official advisory committee established by the Department of the Interior on water quality and was submitted to the Secretary of the Interior, at that time Mr. Udall, by Mr.

Moore, which contained the recommendations of the Nationa Advisory Committee.

I am going to quote from page 12 of that report:

"Fecal streptococci in combination with total coliforms are being used in sanitary evaluation. Selection of techniques to be applied and the interpretation of results are in a state of **flux and** uncertainty. Problems include the unresolved question of whether or not all types of fecal streptococci found in warm-blooded animals are revealed by the tests, the fact that appreciable numbers of streptococci from other sources (plants and insects) yield positive test results, and added time and manpower requirements for monitoring agencies. Fecal streptococci should not be used as primary criteria,but are useful as a supplement to fecal coliforms where more precise determination of sources of contamination is necessary."

Which, as Dr. Morris understands it, supports the statements he made yesterday in connection with that subject.

MR. STEIN: I see Mr. Geldreich. I don't

want to interrupt.

Does this substantially support your position too?

MR. GELDREICH: That is exactly what I am trying to say. I want you to use fecal coliform, period. We went off on a tangent yesterday.

MR. BUCKMASTER: At long last we got what you were trying to say.

MR. STEIN: I think we have agreement, at least in one area. Thank you.

Mr. Buckmaster, will you continue.

MR. BUCKMASTER: Mr. Schliekelman will be the first one to present a matter he would like to bring before this conference.

STATEMENT BY R. J. SCHLIEKELMAN
TECHNICAL SECRETARY, IOWA WATER POLLUTION CONTROL COMMISSION, DES MOINES, IOWA

MR. SCHLIEKELMAN: My name is R. J. Schliekelman. I am the Technical Secretary for the Iowa Water Pollution Control Commission.

R. J. Schliekelman

The statement which we will enter into the record has been given to the recorder, and I will try to summarize a portion of this for the sake of saving time and may also add a few additional statements that do not completely follow the statement itself.

(Which said statement is as follows:)

STATEMENT

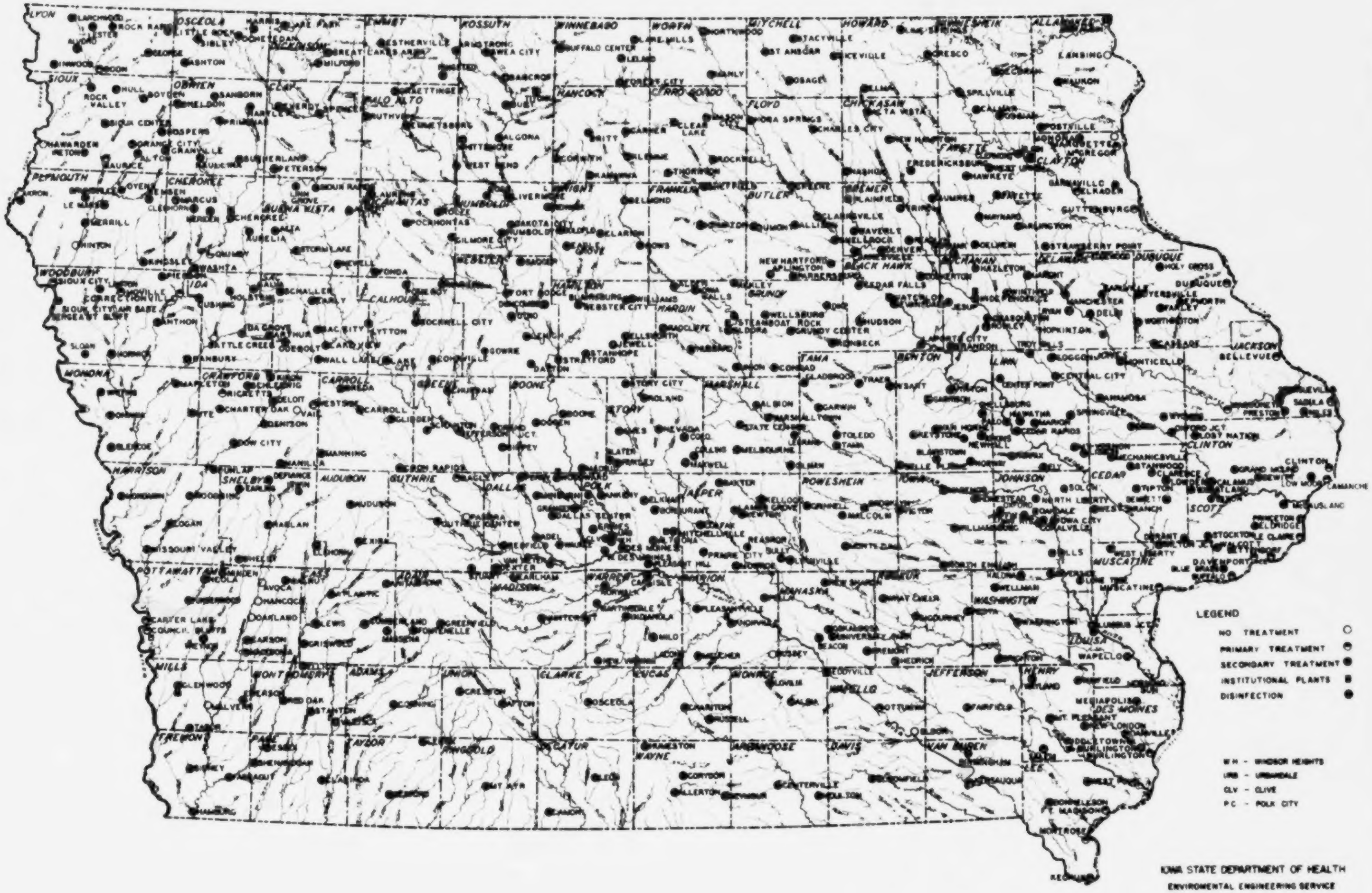
IN SUPPORT OF THE IOWA WATER QUALITY STANDARDS AND PLAN FOR IMPLEMENTATION AND ENFORCEMENT

MISSOURI RIVER BASIN

IOWA WATER POLLUTION CONTROL COMMISSION

APRIL 1969

IOWA WASTEWATER TREATMENT


LEGEND
NO TREATMENT ○
PRIMARY TREATMENT ◒
SECONDARY TREATMENT ●
INSTITUTIONAL PLANTS ■
DISINFECTION ●
W H - WINDSOR HEIGHTS
URB - URBANDALE
CLV - CLIVE
P C - POLK CITY

IOWA STATE DEPARTMENT OF HEALTH
ENVIROMENTAL ENGINEERING SERVICE
AS OF DECEMBER 31, [illegible]

A. INTRODUCTION

By notice of March 5, 1969, the Secretary of Interior called a conference to consider water quality standards for the interstate waters of Iowa. This is a statement of the Iowa Water Pollution Control Commission's position on the matters to be considered at the April 15, 1969 Council Bluffs, Iowa session of the conference. A similar statement, with emphasis on Iowa waters of the Mississippi River basin, was presented at the Davenport, Iowa session of the conference which convened on April 8, 1969. The Iowa Standards apply to all waters of the state and much of the Mississippi statement is repeated herein. However, this statement will discuss matters more specifically pertaining to waters of the Missouri River basin.

The Iowa Water Pollution Control Law, enacted in 1965, created the Iowa Water Pollution Control Commission and charged the Commission, through the administrative and technical staff of the State Health Department, with the general supervision, administration, and enforcement of all laws relating to pollution of the waters of the state. Among the powers and duties of the Commission are those of prescribing rules and regulations, adopting reasonable water quality standards, and developing comprehensive plans and programs for the prevention, control, and abatement of pollution.

The Water Quality Act of 1965, amending the Federal Water Pollution Control Act, provided for establishment of water quality standards for interstate waters. The Act requires the states to adopt such standards which ultimately become Federal standards, after approval by the Secretary of the Interior. With that authority, the State of Iowa ahead of the schedule specified by the Federal Act, filed a letter of intent to adopt standards, held public hearings on the proposed criteria, and adopted the standards which include the water quality criteria and a plan for implementation. The standards were submitted to the Secretary, and after close liason between state and Federal representatives and after numerous conferences and correspondence attempting to agree on a mutually acceptable document, the Secretary determined that certain of the provisions were not approvable as Federal standards, and called a standards setting conference.

The purpose of this statement is to set out the State of Iowa's position on the matters of disagreement. The Federal position is outlined in a report prepared by the Missouri Basin Region of the Federal Water Pollution Control Administration, for the Water Quality Standards Conference convening April 15, 1969. The report is comprehensive and contains a wealth of detailed background information and technical discussion, so no attempt will be made to duplicate or enlarge on that aspect. However, as with the Federal Water Pollution Control Administration report on the Mississippi River basin, there is considerable discussion of such aspects as turbidity and bacterial and nutrient loading from agricultural land runoff, and also of conditions resulting in large part from waste discharges from Nebraska. Such aspects, while appearing to discredit the water quality and the state's pollution control efforts, but being actually outside the scope of Iowa Water Pollution Control Commission control, are not at all at issue in the matters being considered by the conference. To the casual reader, such discussion tends to create false impressions of wide spread pollution and ineffective control. This statement therefore, is an attempt to put the issues in context, to clarify the Iowa position on matters actually in controversy, and to present the positive aspects of the Iowa program.

Part B will outline the Iowa policy and review past and present pollution control in the state. Parts C and D will comment on the background information and summary and conclusions and recommendations presented in the Federal report. Finally, the Iowa Water Pollution Control Commission has during past months of negotiation agreed on certain revisions of the standards and implementation plan, and these are summarized in Section E.

B. STATEMENT OF POLICY AND THE PAST AND PRESENT IOWA WATER POLLUTION CONTROL PROGRAM

The present authority for stream pollution control in the State of Iowa is embodied in Chapter 455B of the state code, the "Iowa Water Pollution Control Law". Enacted in 1965, it created the Iowa Water Pollution Control Commission.

The conduct of the program, as intended by the legislature and as actually being implemented by the Commission and the State Health Department, can best be expressed by the statement of policy as written into the law;

> "455B.1 Statement of Policy. Whereas the pollution of the waters of this state constitutes a menace to public health and welfare, creates public nuisances, is harmful to wildlife, fish and aquatic life, and impairs domestic, agricultural, industrial, recreational and other legitimate beneficial uses of water, and whereas the problem of water pollution in this state is closely related to the problem of water pollution in adjoining states, it is hereby declared to be the public policy of this state to conserve the waters of the state and to protect, maintain and improve the quality thereof for public water supplies, for the propogation of wildlife, fish and aquatic life, and for domestic agricultural, industrial, recreational and other legitimate (beneficial) uses; to provide that no waste be discharged into any waters of the state without first being given the degree of treatment necessary to protect the legitimate (beneficial) uses of such waters; to provide for the prevention, abatement and control of new, increasing, potential, or existing water pollution; and to co-operate with other agencies of the state, agencies of other states and the federal government in carrying out these objectives. (61GA, ch 375, §1)"

This policy, not in the least inconsistent with the present Federal Act, was enacted prior to approval of the amendments in the Water Quality Act of 1965.

As present policy, it evolves from and reflects long and continued progress of stream pollution control in Iowa. The progress can be seen in a brief history of stream pollution control accomplishments.

The first law, passed in 1923, gave the State Department of Health regulatory and enforcement authority. Even before that, Iowa was "ahead of the program". The Department of Health working under legislative authority for supervision over the installation and operation of sewerage works and control of nuisances, and towns recognizing the public health and clean streams need for sewage treatment, had already begun stream pollution control. At the time the 1923 law was passed, nearly 200 municipal sewage treatment plants were already in operation. These being in the smaller towns, only 350,000 some persons were being served by the plants, and this represented only 30% of the population being served by municipal sewer systems. However, this was a good start.

The program operated under the same authority for many years. Then in 1949, the law was changed, among other things, adding a sewage disposal permit feature. By reviewing treatment plant construction plans and specifications required to obtain a permit, the State Health Department could insure that any proposed plant was capable of producing an effluent of sufficiently high quality to protect the receiving stream. Essentially no sanitary sewer permits have been granted unless served by a treatment plant, and in particular, a treatment plant operating satisfactorily. Although this philosophy had been in effect as a matter of policy for many years, the permit feature formalized the policy.

No combined sewers have been approved in Iowa for the last 40 years.

At the time of the 1949 legislation, some 230 municipal treatment plants were in operation. Some of the new plants were constructed by the larger municipalities, so the capacity of the 230 plants was almost three times that of 1923, and the plants were serving approximately 70% of the sewered population.

In recognition of the fact that treatment plant construction is effective only if operation is efficient and competent, an operator training and voluntary certification program was implemented in 1952. In 1965, legislation was passed and implemented, and Iowa is now one of only 17 states with a mandatory operator certification law. The operator training program has expanded and thrived. Under the cooperative effort of the State Health Department, the Iowa Water Pollution Control Association, and the State Universities, laboratory courses are conducted at the Universities and regional basic and advanced operation courses are conducted throughout the state.

From 1949, plant construction steadily and dramatically progressed, and in 1965 some 400 plants were in operation. This represented an increase in population served by treatment to approximately 97.5% of the sewered population.

The 1949 law lifted a previous restriction, so that effective in 1951, Mississippi and Missouri River cities and towns were subject to all provisions of the stream pollution control law. In recognition of common interests in water quality, Iowa in 1952 entered into a tri-state agreement with Illinois and Wisconsin, resolving to require any such corrections of pollution conditions needed to render Mississippi River waters suitable for all purposes.

On the Missouri River also, Iowa as a member of the Missouri Basin Health Council, agreed to and participated in adoption of a similar "Guide for Water Pollution Control Activities." The several states of the Council in 1952 agreed to a program for elimination of toxic substances and settleable and floatable solids, and treatment of industrial wastes as necessary to prevent deterioration of water quality, and to provide treatment over and above removal of settleable and floatable solids as necessary to protect downstream water uses. The Guide also provided for future programs for legislation, construction of treatment plants, improvement of plant operation and maintenance and stream surveillance.

1965 was the year of enactment of the present pollution control law and formation of the Commission. In addition to retention of the permit feature, the new law provided improved enforcement provisions, and authorization for rules and regulations and water quality standards. It should be noted that this Iowa requirement for water quality standards, proven to be consistent with the Federal act, was imposed prior to the water quality amendments of the Federal act.

Since the current law was passed, the Commission has adopted three regulations to aid in surveillance and enforcement. The first is a regulation relating to the General Criteria of the water quality standards, which makes mandatory the effective removal of settleable and floatable solids from municipal waste water discharges. The water quality criteria which apply to all surface waters at all times and places, require that the surface waters be free from floatable and settleable solids which could form putrescent and objectionable sludge deposits and be otherwise unsightly and deleterious. This general criteria has been effective in demonstrating conditions of pollution and has been used as the basis for ordering corrections. However, removal of settleable and floatable solids in most cases does not satisfactorily meet the standards, and the public water supply, aquatic life and recreation criteria have necessitated secondary treatment on virtually all interior streams.

Rules and regulations also require submission of monthly treatment plant operation reports. By specifying format and content, the Department can require reporting of sufficient flow and laboratory testing data to evaluate plant effectiveness, and thereby obtain an indication of the plant's affect on receiving stream water quality. To aid in more efficient and effective use of the repotts, a program for computer scanning of the reports is in the final stage of development.

The Iowa "Mail Order BOD" program has also proven effective in surveillance of treatment plants. This program, which utilizes a technique for fixing samples in the field in preparation for BOD determination in the State Laboratory, eliminates the need for refrigeration and enables transportation to the laboratory by ordinary mail. It is a unique procedure and was developed in the State Hygienic Laboratory.

Although not yet having legislative approval, a third regulation has been adopted by the Commission requiring control of feedlot runoff. Feedlot pollution is being effectively controlled through the present enforcement provisions of the Law, utilizing the water quality standards and definition of stream pollution, but approval of the regulation will hopefully reduce staff time required and prove to be a more efficient and effective means of control.

Using the various regulations and enforcement provisions, the Commission since its inception in 1965 has issued 114 orders for correction of pollution conditions. The point is that the orders, along with more informal education and persuasion efforts during routine plant inspections and contacts with municipal and industrial officials, and more importantly with the understanding and cooperation of local officials, are getting waste treatment facilities built and efficiently operated. As of January 1, 1969 there were 510 municipal plants in operation or under construction, and the population served by treatment has increased to 99.3% of the sewered population. The 13,000 population in municipalities not yet treating, represent plants in the engineering planning stage or actually under orders to be under construction in 1970 or before. Municipalities not presently treating are smaller communities, and 100% of the medium size and large communities do have sewage treatment. This record ranks with the highest in the nation.

Reproduced from best available copy.

Of the industries, the Iowa Meat Packing Plants are the largest potential sources of pollution. Every meat packing plant in the state has a treatment plant in operation or under construction, and this represents some 3.5 million population equivalent being treated. Some of the plants are realizing as much as 98 or 99% BOD removal, due in significant part to pioneering and development of anaerobic/aerobic lagoon treatment in Iowa. With the exception of those on border streams, all packing plant wastes receive at least secondary treatment.

Other wet process industries, though not producing the magnitude of waste produced in meat packing, are subject to and complying with treatment requirements (or if more appropriate, some type of inplant control), to meet Iowa water quality standards. Iowa has no provision for untreated waste discharge permits.

It is significant that Iowa does not have stream classification. Although the standards do specify recreation, fishing, and public water supply uses, and areas of applicability have been defined, minimum defined standards of high quality apply to all waters of the state.

In summary, Iowa has through the years recognized the need for clean streams and continued and expanded its programs to meet the need. The regulatory agency has exercised it's authority to abate pollution and maintain and improve water quality, and municipalities and industries have complied with the requirements. The accomplishments shown by the record can be compared with the best in the nation. Despite the adverse impressions created by the Federal reports and the Secretary's decision to except certain provisions of the Standards, Iowa has in the past and will in the future exercise it's regulatory authority to the fullest legal extent.

IOWA LEADS NATION IN SEWAGE TREATMENT

No Urban Population Without Treatment

TABLE 3. URBAN POPULATION SERVED BY ADEQUATE AND LESS THAN ADEQUATE MUNICIPAL WASTE TREATMENT FACILITIES AND URBAN POPULATION NOT SERVED, BY STATE: FY 1968

(In thousands, except percent)

State	Total Urban Population	Population Served By (Facilities): Adequate	Less than Adequate	None	% of Pop. with less than Adequate or None
U.S 1/	145,602	81,703	31,865	32,293	44.1
Ala.	2,140	819	678	643	61.7
Alaska 2/	121	19		102	84.2
Ariz.	1,411	711	34	666	49.6
Ark.	937	684	156	97	27.0
Calif 2/	17,651	12,766	36	4,849	27.7
Colo.	1,602	854	593	155	46.7
Conn.	2,342	312	1,286	744	86.7
Del.	356	9	267	80	97.5
D. C.	832	832			
Fla 2/	4,860	1,741	864	2,255	64.2
Ga.	2,727	1,081	1,003	643	60.4
Hawaii 2/	591	162		429	72.6
Idaho.	349	160	134	55	54.2
Ill.	8,923	7,410	586	927	17.0
Ind.	3,182	2,286	529	367	28.2
Iowa 1/ 2/	1,526 1/	1,590		1/	
Kans 2/	1,475	1,267	192	16	14.1
Ky.	1,539	536	792	211	65.2
La.	2,479	818	515	1,146	67.0
Maine.	509	37	60	412	92.7
Md.	2,785	2,119	162	504	23.9
Mass 2/	4,563	1,729	1,173	1,661	62.1
Mich.	6,377	1,340	4,223	814	79.0
Minn.	2,370	769	1,324	277	67.6
Miss.	988	460	23	505	53.4
Mo 2/	3,141	2,522	183	436	19.7
Mont 1/	379 1/	123	263	1/	69.4
Nebr 1/ 2/	846	833	100	1/	11.8
Nev.	376	366	6	4	2.7
N. H.	414	43	102	269	89.6
N. J.	6,444	1,629	3,179	1,636	74.7
N. Mex.	764	671	5	88	12.2
N. Y.	16,003	8,017	3,733	4,253	49.9
N. C.	2,138	1,447	125	566	32.3
N. Dak 1/	254 1/	278	15	1/	5.9
Ohio.	7,870	4,591	2,071	1,208	41.7
Okla.	1,694	1,332	199	163	21.4
Oreg.	1,320	552	504	264	58.2
Pa.	8,428	5,325	2,916	187	36.8
R. I.	793	395	190	208	50.2
S. C.	1,134	540	178	416	52.4
S. Dak 1/	287 1/	290	39	1/	13.6
Tenn.	2,214	750	319	1,145	66.1
Tex.	8,874	6,819	130	1,925	23.2
Utah.	825	500	19	306	39.4
Vt.	162	9	121	32	94.4
Va.	2,756	1,092	1,328	336	60.4
Wash 2/	2,139	681	444	1,014	68.2
W. Va.	710	149	348	213	79.0
Wis.	2,804	2,049	689	66	26.9
Wyo 1/ 2/	198 1/	189	29	1/	14.6

← No population without treatment

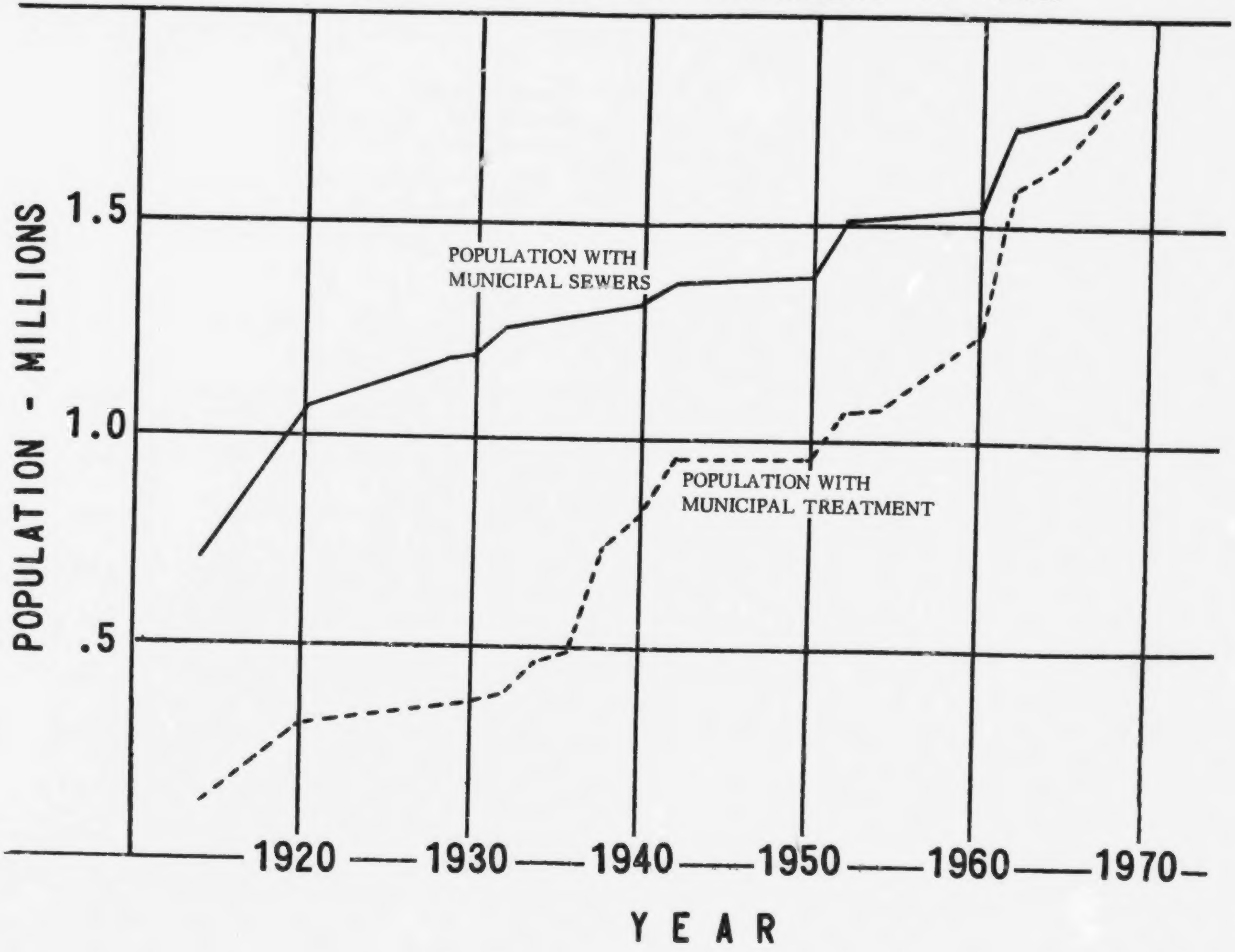
1/ Population served by treatment facilities exceeds total urban population of these States by 259,000 persons. Thus the detail adds to 259,000 more than the total U. S. urban population.

2/ Water quality standards adopted call for primary waste treatment in some urban areas of this State. Standards adopted for other States call for at least secondary waste treatment.

Source: 1962 Inventory, Municipal Waste Facilities in the United States, updated by FWPCA Construction Grants Awards; urban population estimates based on U. S. Census of Population, 1960; Bureau of Census Population Estimates, Series P-25.

From: THE COST OF CLEAR WATER - Volume I Summary Report,
U S Department of Interior, Federal Water Pollution Control Administration
January 10, 1969

MUNICIPAL SEWAGE TREATMENT IN IOWA



MUNICIPAL SEWERAGE SYSTEMS
(Based on 1960 population and special census)
December 31, 1968

	Total Number of Municipalities		Municipalities with Sanitary Sewers		Municipalities -- Treating Sewage		Total Population Treated to Total Sewered Population
Population	No.	Population	No.	Population	No.	Population	Percent
Over 15,000	22	1,083,398	22	1,083,398	22	1,083,398	100.00
2,000-15,000	113	526,269	113	526,269	112	523,725	99.5
1,000-2,000	113	151,515	112	150,391	106	142,588	94.8
500-1,000	207	144,457	176	125,133	173	123,218	98.5
Under 500	495	120,367	101	34,888	97	33,362	95.6
TOTALS	950	2,026,006	524	1,920,079	510	1,906,291	99.3

Compiled by
Environmental Engineering Service
Water Pollution Division
State Department of Health
Des Moines, Iowa

C. COMMENTS ON SUMMARY AND CONCLUSIONS OF THE FEDERAL REPORT

The extensive text is summarized in Section II of the Missouri River Basin Water Quality Standards Conference report. Several of the items deserve comment and are discussed below. The parenthesis indicates material quoted or paraphrased from the Federal report.

Agricultural Runoff Effects

Items E, G, and K on pages II-2 and II-3 deal generally with agricultural runoff effects. While of interest, this particular aspect is actually outside the scope of controllable standards, and the manner of the statements could lead the less than totally informed reader to unwarranted conclusions.

E. (It is estimated that at least 3,300,000 cattle and calves and 6,100,000 hogs and pigs were on farms. These animal wastes have a population equivalent of 65,000,000 and can cause several conditions of stream degradation.) There is no particular problem from animal waste until such time as rainfall, snow melt or water passes through the feed lot dissolving material from the manure and carrying it to the stream. Since the load of dissolved and suspended material water carried to the stream is only a fraction of that on the feed lot, the 65,000,000 population equivalent of animal waste on the feed lots should not at all be interpreted as the load on the stream.

(There are approximately 46,000 feeder lots in the state - page IV-23.) This statement is misleading in that a feeder lot could be defined as an area from which one or more grain-fed beef was marketed during the year. This could not be much of a pollution problem, and certainly not one over which control could be exercised. Iowa does however, effectively control large confinement feed lot runoff pollution.

G. (Sediment from uncontrolled runoff is a major pollutant of the Missouri River.) The reference to low turbidity of water discharged from Gavins Point Dam, compared to the turbid condition through Iowa is understandable. The effect of settling of sediment in the pool above the dam is not available in the lower reaches. Again, this aspect is outside the scope of controllable standards and is not an issue of the Standards conference.

K. (High densities of bacteria and high concentrations of nitrogen and phosphorus are found in Iowa tributaries to the Missouri River, especially during periods of stormwater runoff.) This statement could be expanded to include the agricultural land and streams in all states. Furthermore, while some control may be imposed, the bacteria, nitrogen and phosphorus in stormwater runoff can never be fully abated. Stormwater runoff effects negate at least in part, the desirable effect of continuous disinfection of treatment plant effluents.

Recreational Uses

Items P, Q, and S deal generally with recreational uses and give emphasis to impairment of use by grease.

P. (Recreational activities on the main stem include boating, water skiing, swimming and wading. These activities are directly affected by presence of floating material and grease balls, high bacterial densities, dissolved organics and turbidity. Samples of water taken in the survey had as high as 2000 bacteria per drop.)

Q. (Esthetic values of the waters in this area are reduced due to turbidity, floating materials, and other effects which reduce or eliminate the opportunity for development of spectator oriented activities, e.g., boat or canoe races, etc.)

S. (Fouling of fishnets and lines with grease is common below major municipal and industrial waste outlets. Similarly, boat hulls of recreational watercraft are fouled with grease and scum.)

The Iowa Water Pollution Control Commission has not designated the main stem of the Missouri as a recreation stream involving whole body contact sports (swimming and water skiing). The Iowa Health Department has for many years recommended that Iowa streams not be used for this purpose because of the injury and drowning hazards involved. Section IV of the Federal report contains the following statements which would appear to bear out this position.

Second paragraph, page IV-7 (Present recreation use along the Missouri River in Iowa has not met its potential for the amount of land and water acreage involved. While being light, however, it appears that most recreation activities are participated in with sightseeing, boating, picnicking and fishing as the most popular.) Last paragraph, page IV-7(Water skiing, surprisingly is enjoyed even though the river contains a high silt load. Swimming is not considered a common activity due in large measure to the dangerous water conditions and high turbidity.) Third paragraph, page IV-11-(It can be expected that use on the waters of the Missouri will principally be in the form of fishing, and boating, and on the adjoining lands in the form of sightseeing, picnicking, hiking, driving and walking for pleasure, and in historical interpretation.)

From this, it would appear that there is general agreement that the value of the Missouri River for whole body sports is dictated principally by factors other than controllable water quality criteria, and that maintenance of the general criteria and the criteria for public water supply and aquatic life should adequately protect recreational uses.

The grease ball, grease and scum problems mentioned in items P and S have not been shown to be attributable to the Sioux City or Council Bluffs municipal sewage plant discharges. The discharges which would be most suspected of containing large amounts of grease would be the Iowa Beef Packers discharge at Dakota City, Nebraska, the municipal sewage treatment plant effluent at Sioux City, Iowa, and the City of Omaha discharges. Grease is discussed on page A-26 of the Federal report and this discussion is quoted in its entirety as follows:

(The concentration of grease from the daily composite from the Monroe Street and South Omaha sewers averaged 299 mg/l during the October 1968 survey. The actual amount of grease reaching the Missouri River following a privately operated recovery operation at the Monroe Street sewer was not determined.)

(The grease concentration in the effluent from the Sioux City, Iowa, sewage treatment plant during the October 1968 survey averaged 17 mg/l. The amount of grease removed through the sewage treatment plant was not determined.)

(Grease results from the January 1969 survey were not available for inclusion in this report.)

The amount of grease being discharged (in the Monroe Street sewer) to the private recovery operation, using a total daily flow of 40 million gallons per day as shown in Table A-1, is fifty (50) tons per day. In comparison, the 17 mg/l of grease found in the Sioux City effluent is not significant. The Iowa State Department of Health has found that this amount of grease is not visible in effluents or in the receiving stream. The 17 mg/l of grease amounts to a little over one (1) ton in the Sioux City effluent, as compared to fifty (50) tons being discharged in the Omaha Monroe Street sewer.

The Federal report speaks of grease balls as big as oranges, but does not say where these were observed. Nor does it contain information concerning the grease content of the Iowa Beef Packers effluent at Dakota City, Nebraska. The waste being discharged from Iowa Beef Packers is not treated in a municipal plant and can be expected to contain appreciable amounts of grease. The waste treatment facility consists of an air flotation grease removal unit, the type of which past Health Department observations have shown, present operator problems and is subject to operational outages.

The Iowa State Department of Health has information that the State of Nebraska permitted Iowa Beef Packers at Dakota City to discharge wastes which may be over 200,000 population equivalent, compared to 195,000 population equivalent listed in the Federal report for the Sioux City sewage treatment plant effluent. Grease removals in the Sioux City plant would be much more effective than the IBP industrial unit, so that the grease observation should not be attributed to Sioux City.

Water Quality Effects.

Items L, O, and R on pages II-3, and II-4, discuss certain other water quality effects.

L. (Survey results from the main stream of the Missouri River in Iowa identified adverse changes in water quality. Turbidity increased four-fold in the length of reach surveyed and cyanide and phenols were found) It is true that phenols were found in the Missouri River, however, the Federal report failed to mention in the summary that the maximum observed phenol concentrations (Table No. A-5) did not change from station M-52, which is located above Sioux City, to station M-38, which is located below the Omaha-Council Bluffs area. These maximum levels, which showed no relation to waste discharges, were 2 parts per billion (ppb), which is twice as high as the suggested FWPCA standard of 1 PPb. These data further substantiate Iowa's position that phenol concentrations resulting from natural degradation products often exceed the FWPCA standard of 1 ppb, and that this standard is therefore unreasonable.

During the January, 1969 FWPCA survey, turbidity values were shown to decrease from 19 units above Sioux City to 8 units below Omaha-Council Bluffs. During this period storm water runoff was minimal and these data show that sewage treatment plant discharges had no effect on the turbidity of the Missouri River. High turbidity in the Missouri is caused exclusively by land drainage and that subject is not relevant to the conference.

Cyanide concentrations up to 15.2 ppb were measured in the Missouri River. These concentrations given in Table A-5 bear no apparent relationship to municipal or industrial discharges. 12.2 ppb of cyanide were found above Sioux City while less than 1 ppb was found below the Omaha-Council Bluffs area. In no case was the Iowa aquatic life standard of 25 ppb of cyanide violated.

O. Public water uses relying on the Missouri River as a source of supply report problems associated with turbidity, ammonia, coagulation, taste and odors.) These are common problems of most surface water treatment plants, whether or not being affected by upstream waste discharges. We have already established that turbidity problems in the Missouri are not caused by waste discharges but by land runoff over which we have no control.

Sewage treatment plants are designed to eliminate settleable materials and organic carbon, not ammonia. Waste effluents from secondary treatment plants contain concentrations of ammonia that are many times greater than concentrations in the average receiving waters. Nevertheless, increased ammonia concentrations in the Missouri and other Iowa streams are generally the result of agricultural land drainage and not sewage treatment plant discharges. This is substantiated by the fact that 85% of the Missouri River stations had greater ammonia concentrations during the runoff period than during the normal period of flow (see Table A-3, Federal report).

It has been widely recognized by Iowa that taste and odor problems frequently are encountered during periods of surface runoff, particularly in the late winter and spring. However, this is not related to sewage treatment plant discharges.

R. (Tainting of fish flesh has been reported by commercial and sport fishermen in many areas of the main stem of the Missouri river.) The State Conservation Commission reports no such complaints in the Iowa reach of the River. Again, it should be pointed out that industrial and municipal contributions on the Iowa side of the river are much less than those of adjacent or downstream states.

Treatment Requirements in Other States

Item T states that (Every state which borders the Missouri River, except for Iowa, has adopted as part of its Standards, a minimum requirement for secondary treatment or its equivalent for wastes discharged into the Missouri River.) This Department has been informed by the State of Kansas that Kansas, which borders the Missouri River, has not agreed to a blanket requirement for secondary treatment without such need being demonstrated. The Kansas standards have not yet been approved by the Secretary of the Interior.

The Conference in the matter of pollution of the Missouri River-Omaha area, held in June 1957 by the Public Health Service, recommended that Omaha area cities and towns provide adequate waste treatment. Municipal waste treatment plants were placed in operation by Council Bluffs, Iowa in February 1963 and by Omaha in February 1964.

Failure of the Omaha meat packing plants to remove paunch manure and other solids in pre-treatment produced such severe plant operation problems that the packing plant wastes and the south half of the City of Omaha still remain untreated. Four additional conference sessions ending March 1966 produced an agreement between the packers and the City of Omaha for construction of packing plant waste pre-treatment facilities, scheduled for completion in 1969.

FWFCA Biological Study

The manner in which the biological data was presented did not deviate from the rest of the Federal report. Conclusions were "not objective" and pertinent facts were buried which tended to create the illusion that Iowa is a major polluter of the Missouri River.

The FWPCA summary (part M, page II-3) regarding the biological study states the following. (Biological investigations revealed predominately clean water organisms and associated aquatic life above Sioux City. However a consistent increase in pollution tolerant organisms and biota were observed in many stretches of the river between Sioux City and St. Joseph.) This statement leads one to believe that all is well above Sioux City, whereas the Missouri downstream from Sioux City is polluted. If the data (Table B2-Federal Report) is examined objectively, it is obvious that this statement is misleading.

The fact is that the study showed little difference in the biological quality between station 736 and 730 above the Sioux City sewage treatment plant discharge, whereas every sample taken in the first 74 miles below the Sioux City discharge definitely demonstrated a biological fauna which was superior in quality to that observed upstream from Sioux City. Stoneflies, which are noted for being extremely pollution intolerant, were found at three stations downstream from Sioux City, while the data indicate that no stoneflies were found above Sioux City. Likewise there was a greater diversity of mayflies in the first 74 miles below the Sioux City discharge than there was above Sioux City. Mayflies are also pollution intolerant organisms which require high water quality. The FWPCA data (Table B-2) demonstrate that pollution intolerant forms were present in greater diversity in the first 74 miles below the Sioux City discharge than above it. This not a claim that the treated waste discharge from Sioux City enhances biological quality in the Missouri River, but merely points out that the biological quality was not deteriorated at these stations by the Sioux City discharge.

It is stated in the Federal report (page B-1) that severe degradation of the bottom associated organisms occurred for 54 miles downstream from the Omaha-Council Bluffs area, and that floating solids (grease and chunks of animal fat) were observed for 166 miles downstream.

It is interesting to compare the waste contribution of Omaha, Nebraska and Council Bluffs, Iowa. This can be readily done by a few simple calculations using the data given on page IV-24 of the Federal report. Omaha, Nebraska discharges 1,801,640 P.E. to the river, or 46 times as much as the Council Bluffs 39,000 P.E. discharge. Omaha's waste load to the river thus exceeds the sum total waste load discharged by the 20 Iowa municipalities (including industries) which are located on the Mississippi River.

Eighty-eight percent of Omaha's raw waste load receives no treatment or, in other words, is discharged directly to the Missouri River. All of the Council Bluffs waste receives primary treatment.

It is therefore not all surprising that the Missouri is biologically degraded for 54 miles below Omaha, nor is it surprising that grease balls are found as far as 166 miles downstream. However, these conditions can hardly be attributed to Council Bluffs, Iowa.

Water Quality Monitoring

(Pages IV-41, IV-42 and IV-43 of the Federal report contain discussion of the need for water quality monitoring and recommendations that Iowa establish additional monitoring stations and increase sampling frequency.)

The Iowa Water Pollution Control Commission agrees that an adequate water quality monitoring program is necessary and that this program should fit the needs of all the agencies involved in water pollution control. This is further emphasized by sections of this statement recommending additional study of parameters at issue in the Standards Conference. However, the extent of monitoring is directly dictated by staff manpower capability. This, being an extremely small staff agency, priorities must be established.

Iowa has recently expanded its limnology program, which is a direct increase in monitoring effort. Iowa has also moved forward by development of the mandatory treatment plant operation report program. This, together with automatic data processing, mandatory operator certification, and mail order BOD, is a form of monitoring, but monitoring of sources of waste discharge rather than stream water quality. However, priority must be given to correction of poor effluent discharges rather than stream sampling, and this effort is a more efficient utilization of staff resources. Such sampling as is now possible is being carried out, and every effort will be made to expand the monitoring station network and increase sampling frequency as manpower increases permit.

D. COMMENTS ON FEDERAL RECOMMENDATIONS

The recommendations of the Department of the Interior are set out, starting on page VI-1 of the Water Quality Standards Conference Report-Missouri River Basin. The Iowa position on each of the recommendations is outlined below, in the same order as it appears in the Federal Report.

Secondary Treatment

The Department of Interior blanket requirement for secondary treatment of all municipal and biodegradable wastes cannot be justified on the basis of Congressional intent, nor can such a requirement be adopted by the Commission under present Iowa statutory authority. An effluent standards provision, such as this secondary treatment requirement, was rejected during early Congressional hearings, and the standards provision reported out of Committee contemplated the setting of water quality standards for receiving waters only. However, on the basis of Guideline 8, the Department of Interior has attempted to impose a uniform requirement of secondary treatment or the equivalent, in all State water quality standards.

The Commission, under Iowa law, has no direct statutory authority to establish or enforce effluent standards. There is no authority to specify a type of treatment, except that based on the water quality criteria of the receiving stream. Treatment can be regulated only to the extent that it will produce an effluent that will protect the stream and meet the water quality criteria.

On the basis of stream water quality requirements, secondary treatment will be needed, and therefore has or will be required for all but 4 or 5 of the 490 municipal sewage treatment plants located on interior streams. However, the Mississippi and Missouri rivers have very high stream flows furnishing very high assimilative capacity, and the need for a degree of treatment higher than primary is difficult and in most places impossible to demonstrate. Extensive Mississippi River water quality studies during the middle 1950's and a 1950 pollution investigation on the Missouri River, demonstrated relatively little effect of even untreated wastes on these border streams. But as the result of water pollution hearings and voluntary compliance, all cities and towns, with the exception of the small Mississippi River towns of Marquette and Lansing, completed primary or secondary treatment during the 1950 to 1966 period.

The dissolved oxygen values presented in Figure A-2 of the Federal report indicate no significant decrease in dissolved oxygen during the October 1968 survey period, and an actual increase progressing downstream to the Omaha area during the January 1969 period.

The principal oxygen demanding sources now existing in the Sioux City area are the primary treated effluent of the City of Sioux City and the relatively untreated waste from the Iowa Beef Packers plant at Dakota City, Nebraska, approximately 4 miles downstream from the Sioux City municipal sewage treatment outfall. As determined from samples collected by FWPCA and from composite plant operation reports submitted to the State Department of Health, the Sioux City plant effluent has a population equivalent waste loading in the range of 200,000. No similar composite samples were collected by the FWPCA from the effluent of the Iowa Beef Packers plant at Dakota City, but information available to this Department indicates that the State of Nebraska has permitted the Iowa Beef Packers plant to discharge an organic load of over 200,000 population equivalent to the Missouri river. It can be seen that this oxygen demanding waste load figure may be equal to that contributed by the entire domestic population of Sioux City and its packing plant waste load combined.

The table of municipal discharges to the Missouri river on page IV-24 of the Federal report lists a plant discharge population of 39,000 for Council Bluffs, Iowa and over 1,801,000 for Omaha, Nebraska. The oxygen demanding wastes for Omaha are thus 46 times that of Council Bluffs. Some oxygen depression was created by the discharge of primarily untreated wastes in this area but could not be declared to have a serious detrimental effect.

These water quality studies have shown no significant reduction in dissolved oxygen levels below sources of oxygen demanding wastes, even prior to primary treatment. This is a fortunate condition, and fares well compared to others of the nation's major streams where secondary treatment is needed. For instance, the 1968 report of the Ohio River Valley Water Sanitation Commission showed that dissolved oxygen levels of below 4 ppm occurred 33% of the time in the lower reaches of the Ohio River. Likewise, the lower reaches of the Delaware River now have very low oxygen levels, and hundreds of millions of dollars must be expended for secondary treatment, simply to maintain 3.5 ppm dissolved oxygen.

It also deserves comment that most of the larger border cities proceeded with primary treatment in the early years of the Federal construction grant program, and did not enjoy the degree of financial assistance that will be available to cities in other States that have delayed any plant construction to this point.

Using cost figures compiled by Smith and published in the JWPCF, it has been estimated that construction of secondary treatment facilities for all waste discharges to the Mississippi and Missouri Rivers would cost over $25 million. Furthermore, according to figures published in a 1969 FWPCA report, the cost of operation and maintenance of these secondary plants would be approximately $1.7 million per year more than for primary treatment.

The Iowa Water Pollution Control Commission has no hesitancy to require secondary treatment of any waste discharge to either the Mississippi or Missouri Rivers, when the need to satisfy water quality requirements is shown. However, it is the Iowa position that a need for uniform secondary treatment of all waste discharges has not been shown, and there is no scientific reason to believe that secondary treatment of every waste discharge on the border streams will enhance the water quality.

Some degradation of water quality was evident below the Omaha-Council Bluffs area due to the low percentage of wastes receiving treatment. It is suggested additional water quality studies be conducted following completion of meat packing plant pretreatment facilities to permit evaluation of Missouri river water quality when receiving full primary treated effluents from the City of Omaha.

Disinfection

At a meeting on February 9, 1968 with Robert S. Burd, Director of the FWPCA Water Quality Standards Staff, Iowa agreed to adopt definite numerical bacteriological limits compatible with National Technical Advisory Committee recommendations for waters used for public water supplies and primary contact recreation (swimming and water skiing). Interior further agreed that the standards would recognize these values as applying during dry weather, but will state that all reasonable efforts will be made to reduce bacteria concentration increases during periods of storm water runoff.

The Iowa Water Pollution Control Commission at its April 4, 1968 meeting approved a motion accepting these provisions, and the Iowa water quality standards have been revised to include the following numerical bacteriological limits:

Public water supply

Numerical bacteriological limits of 2000 fecal coliforms per 100 ml for public water supply raw water sources will be applicable during low flow periods when such bacteria can be demonstrated to be attributed to pollution by sewage.

Recreation

Numerical bacteriological limits of 200 fecal coliforms per 100 ml for primary contact recreational waters will be applicable during low flow periods when such bacteria can be demonstrated to be attributable to pollution by sewage.

The water quality criteria and plan for implementation and enforcement for the surface waters of Iowa, adopted by the Iowa Water Pollution Control Commission in May 1967, designated the surface waters to be protected for public water supply use as well as the recreation use areas on lakes, impoundments and rivers. The treatment needs in the plan have specified coliform reduction or effluent disinfection by the municipalities to protect this use during the recreational season. Information provided by other state agencies and presentations at the public water quality hearings were used to designate interior stream recreation areas, and coliform reduction has been specified for interior municipalities where necessary to protect recreational uses.

The State of Iowa therefore feels that acceptable bacterial criteria have been established for interstate streams in Iowa. These criteria are compatible with criteria of adjoining states established for public water supply and for recreation. Other state bacterial criteria generally take into consideration the effect of land runoff, and are applied when necessary to protect specified uses. Disinfection of treatment plant effluents is required by states adjoining Iowa, generally where public water supplies are involved and where necessary to protect public health for recreational waters during the recreational season. The State of Iowa had previously gone on record in its implementation plan as requiring effluent disinfection where necessary to protect downstream water uses.

Land runoff contributes high bacterial densities and bacterial studies in the State of Iowa and elsewhere have shown that commonly acceptable coliform levels have been greatly exceeded even in the absence of wastes attributable to human sources. The following is quoted from a long term study (1) of total coliforms in the Iowa River at Iowa City.

"If a stream contains coliform organisms that are of domestic sewage origin, one might expect the MPN to vary inversely with the dilution capacity of the stream. High MPN values would be expected during the dry seasons. On the other hand, high turbidities would be expected with high water conditions due to increased erosion and scour.

"In the Iowa River, increases in stream flow are accompanied by increases in both turbidity and coliform organisms. This pattern has been apparent over the entire 1950-64 period and is true whether one examines daily or monthly average data.

"Apparently, large numbers of coliform organisms are carried into the river after each rainfall and snow melt. The increase in turbidity also indicates the agricultural land adjacent to the river as the source of many of these coliform organisms. Storm sewer overflow is not considered a significant factor because the nearest upstream city is 30 mi. above Iowa City, and above the impoundment.

"In view of the apparently high numbers of nonfecal coliform organisims, and the correlation of high coliform densities with high flow, one might question the significance of such MPN data as related to the bacterial safety of the Iowa River Water. Does a high MPN, expecially a high monthly average, which may be caused by runoff from a single rainfall, mean that this water is an undesirable source? Probably not."

Among his conclusions Professor Powell states: "There are considerable seasonal differences in water quality. The impoundment has tended to reduce this variation, for example, by distributing the poor water from spring runoff over a longer period of time.

"Stream flow, turbidity, and bacterial density follow the same seasonal pattern. Increases in flow are accompanied by increases in the other two. During high flows the extremely high coliform densities are due to agricultural land drainage.

"Improved methods of evaluating bacterial quality and recommending treatment are greatly needed. In view of present day treatment capabilities, the worst rivers in the country can probably be purified with relative ease."

(1) Water Quality Changes Due to Impoundment, Marcus P. Powell & P. M. Berthouex, JAWWA July 1967

Figure 1 illustrates the pattern, on a monthly average basis, of the direct relationship of increasing stream flows accompanied by increases in both turbidity and total coliform density. Figure 2 indicates that the monthly coliform MPN average is less than 5000 per 100 m/l about 46% of the months both before and after impoundment above the supply in 1958. Figure 3 illustrates coliform variations with flow and turbidity on the Raccoon River at Des Moines.

Tables 2 and 3 contain total coliform data for the years 1964 & 1965 raw water at the University of Iowa water treatment plant intake at Iowa City, Iowa. This data indicates that commonly accepted total coliform criteria both for public water supply and recreation uses are exceeded due to land runoff a high percentage of the time.

The following are estimates of the costs for continuous disinfection (chlorination) of municipal waste treatment plant effluents, including effluents from industrial wastes which may contain pathogenic agents as recommended by the Department of Interior.

Estimated Chlorination Costs
Iowa Cities and Towns on Interstate Streams

	Raw PE	Eff. PE	Construct. & Equip. costs	Annual Chlorine cost
Major Mississippi River cities	1,029,000	700,000	$ 642,000	$390,000
Major Missouri River cities	447,000	295,000	307,000	176,000
Interior Interstate Streams			1,400,000	291,000
Total Chlorination Costs			$2,394,000	$857,000

The expenditure annually of the large sums of money required for year-round disinfection of municipal and industrial wastes as recommended by FWPCA, will not improve the bacterial quality of interstate waters during periods of run-off, and these are the periods when high bacterial levels have been found. The Iowa Water Pollution Control Commission has agreed to disinfection of waste discharges where these discharges can be expected to affect recreational or public water supply uses. Primary body contact (swimming and water skiing) recreational uses of Iowa streams is limited by nature to summer months. It has not been demonstrated to the Iowa Water Pollution Control Commission that year round chlorination is required to protect secondary contact (boating and fishing) recreational uses.

The Missouri River being unsuitable for whole body contact recreational sports (swimming and water skiing), precludes the need for disinfection to protect this use. The one possible need for disinfection would be at the Sioux City area to protect the downstream water supplies. However, that need, as demonstrated by the FWPCA water quality study, appears to be rather borderline, and the study was relatively brief. Therefore before definitely establishing a compliance requirement and making the large expenditure that will be required, additional study should be undertaken to more accurately determine the coliform densities and sources.

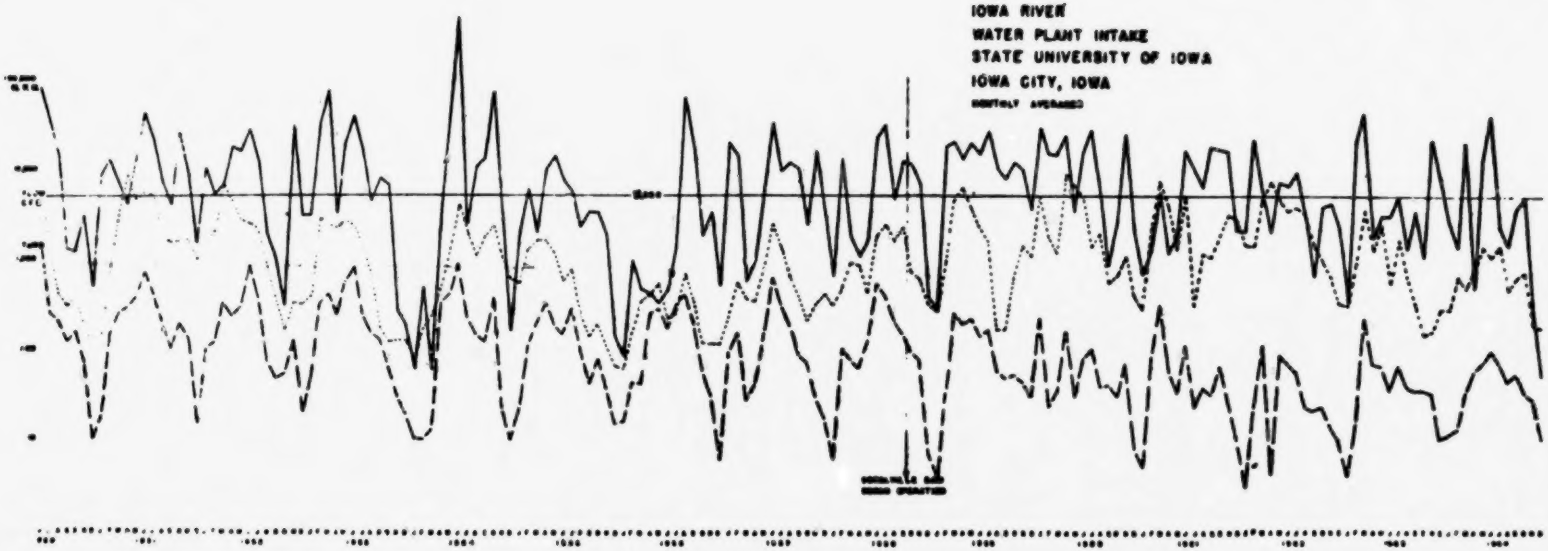
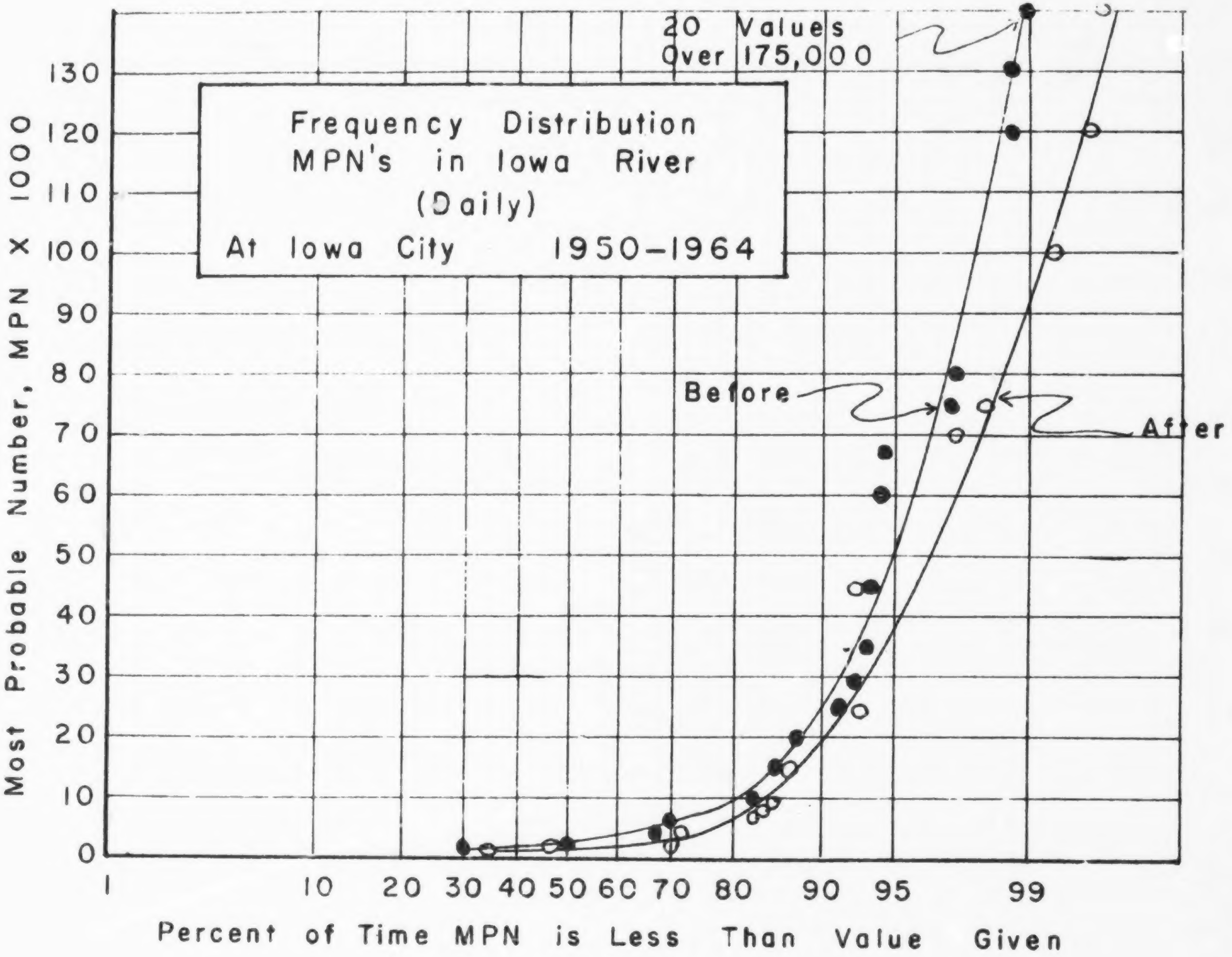

IOWA RIVER
WATER PLANT INTAKE
STATE UNIVERSITY OF IOWA
IOWA CITY, IOWA
MONTHLY AVERAGED

FIGURE 1



Frequency Distribution
MPN's in Iowa River
(Daily)
At Iowa City 1950–1964
20 Values
Over 175,000
Before
After
Most Probable Number, MPN X 1000
0
10
20
30
40
50
60
70
80
90
100
110
120
130
1
10
20
30
40
50
60
70
80
90
95
99
Percent of Time MPN is Less Than Value Given

Figure 2

FIGURE 3

MPN COLIFORM ORGANISMS
RACCOON RIVER - DES MOINES
JUNE 15 - DECEMBER 31, 1953
(DAILY DETERMINATIONS)

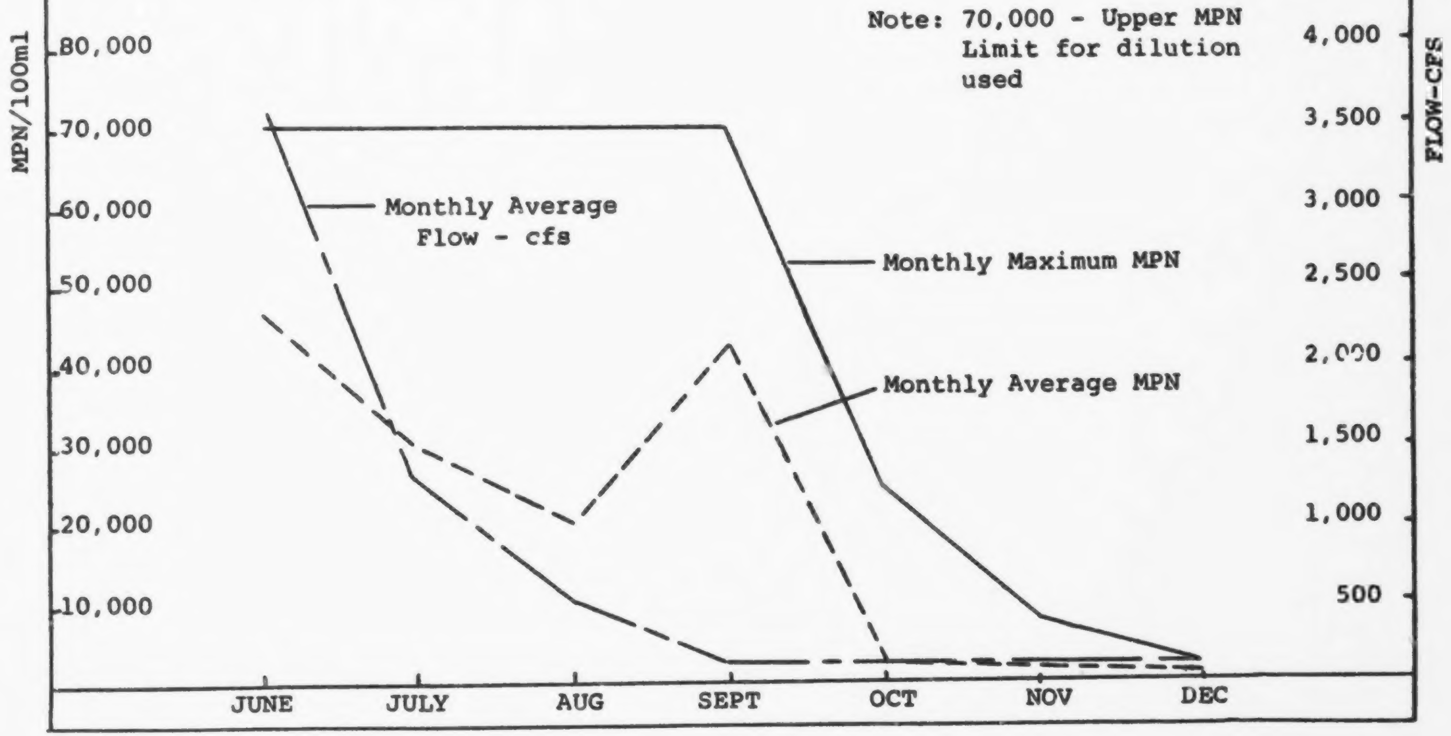


TABLE 2

IOWA RIVER
WATER PLANT INTAKE
UNIVERSITY OF IOWA
TOTAL COLIFORM M.P.N. DATA
1964

Month	Number of Samples	Ave. MPN per 100 ml	Public Water Supply		Recreation*				Mean Flow cfs
			% > MPN	% > MPN	% > MPN		% > MPN		
			5,000 per 100 ml	20,000 per 100 ml	1,000 per 100 ml	2,000 per 100 ml	2,400 per 100 ml	5,000 per 100 ml	
Jan.	17	2,780	11	05	41	41	23	11	187
Feb.	19	1,335	05	0	31	21	15	05	655
March	20	5,890	20	10	55	45	45	20	467
April	22	478	0	0	09	09	09	0	803
May	19	10,240	31	05	78	78	78	31	1,391
June	22	22,980	50	22	81	77	77	50	1,040
July	22	2,240	18	0	63	45	36	18	1,355
Aug.	21	1,450	04	0	14	14	14	04	452
Sept.	21	3,700	14	04	61	52	52	14	637
Oct.	21	4,970	14	09	38	38	33	14	213
Nov.	20	206	0	0	0	05	0	0	294
Dec.	21	51	0	0	0	0	0	0	419

*When averaging MPN values all values less than 30 were considered 30.

TABLE 3

IOWA RIVER
UNIVERSITY OF IOWA
WATER PLANT INTAKE
TOTAL COLIFORM MPN DATA
1965

			Public Water Supply		Recreation				
Month	Number of Samples	Ave. MPN per 100 ml	% > MPN 5,000 per 100 ml	% > MPN 20,000 per 100 ml	% > MPN 1,000 per 100 ml	2,000 per 100 ml	% > MPN 2,400 per 100 ml	5,000 per 100 ml	Mean Flow cfs
Jan.	20	37	0	0	0	0	0	0	1,282
Feb.	20	46,000	30	30	35	35	30	30	2,039
March	23	15,000	48	13	96	87	70	48	3,388
April	27	32,000	52	33	78	74	59	52	6,257
May	20	17,000	65	20	85	85	80	65	4,989
June	22	5,100	18	9	46	41	32	18	5,633
July	21	6,100	29	14	62	57	48	29	2,661
Aug.	22	27,000	41	27	77	77	59	41	513
Sept.	21	38,000	77	53	90	90	86	77	2,651
Oct.	20	2,100	5	0	40	30	15	5	3,593
Nov.	21	670	0	0	14	5	0	0	4,025
Dec.	20	12,000	15	10	30	25	20	15	3,807

*When averaging MPN values all values less than 30 were considered 30 and all values greater than 110,000 were considered 110,000

Temperature

The temperature criteria for interior streams was excepted from approval by Secretary of Interior. During the lengthy negotiations, the temperature criteria has been the subject of wide variation and inconsistency in the Department of Interior's position. In five separate expressions, for instance, Interior has requested different maximum temperature requirements, ranging from 86°F to 93°F.

Agreement was reached on the 93°F maximum on interior streams but not on permitting a differential of 10°F above the natural background. Interior has insisted that this follow the pattern of the larger streams, like the Mississippi and the Missouri, dictating a differential of 5°F above natural background from May 1 through October 1, and then 10°F October 1 through May 1. This issue is unwarranted and would seriously add to the expense of power plant operations where applicable.

The thermal loading in Iowa is primarily from electrical power generation. Other industries using river water for heat exchange work are not believed to be of such magnitude as to exceed the lower limit proposed when operating plants on respective streams at low flow conditions. This leaves then, only those power plants which can properly and economically use this resource when able to stay below the maximum stream temperature set forth by the criteria.

The trend in this area should be noted. Older power plants are being closed rather than expend funds for modernization of air and water pollution control facilities and for other operational reasons. These services are being replaced by transmission of electrical currents from other larger and more modern plants. With the forthcoming of the atomic power plants in this region, increases in the thermal loading at these smaller local points on the interior streams, does not appear to be a problem for the near future.

The several guidelines issued by the National Technical Advisory Committee, describing considerations for setting temperature limits, frequently refer to the need for local study and for specific analysis of each habitat at the zone in question. Iowa believes this to be a most valid consideration and submits to the expert opinions of those professional authorities who have conducted investigations and have knowledge of the aquatic life on the streams where such concern may exist.

The temperature limits in the standards were not finally established until after the seven hearings conducted throughout the state. The final criteria were considered to be a fair representation of values recommended by and acceptable to various biologists who testified at the hearings. The views of the Superintendent of the Biology Section of the State Conservation Commission and the Principal Limnologist of the State Hygienic Laboratory are also firm in the contention that the temperature maximums and the 10°F temperature rise on interior streams are acceptable standards for aquatic life.

The recommendations of the Federal Report on the Missouri Basin water are quite vague in regard to temperature maximums, but a February 21, 1968 letter from Robert S. Burd, director of the FWPCA Water Quality Standards Staff, definitely stated that the maximums then proposed in the Iowa Standards were acceptable, and indicated that the 10°F rise on interior streams was the only point at issue.

Iowa believes however, that the first hand knowledge of the problems involved and the subsequent testimonies of the professional authorities who counseled in preparation of the temperature standards, are logical and valid reasons for retaining the 10° tolerance above natural temperatures on interior streams. The 93° maximum temperature should also be retained.

Further, it should be recorded that all industry sharing this thermal pollution problem has cooperated with the Iowa Water Pollution Control Commission and adjusted its agreements to assure compliance within the parameters desired by the Commission. Industry is seriously concerned when reviewing the various thinking, and changes in position expressed in letters coming from the FWPCA, each adding to and further restricting their right for using this resource. Iowa believes the balance it has recommended to be both reasonable and valid for water quality temperature criteria in Iowa.

Protection of High Quality Waters

The October 2, 1968 minutes of the Iowa Water Pollution Control Commission state that the language of the non-degradation clause which was accepted by the state of Colorado and adjacent states is acceptable to the Water Pollution Control Commission. This action is considered firm, and the following non-degradation statement is incorporated as a part of the water quality standards:

> Waters whose existing quality is better than the established standards as of the date on which such standards become effective will be maintained at high quality unless it has been affirmatively demonstrated to the State that a change is justifiable as a result of necessary economic or social development and will not preclude present and anticipated use of such waters. Any industrial, public or private project or development which would constitute a new source of pollution or an increased source of pollution to high quality waters will be required to provide the necessary degree of waste treatment to maintain high water quality. In implementing this policy, the Secretary of the Interior will be kept advised and will be provided with such information as he will need to discharge his responsibilities under the Federal Water Pollution Control Act, as amended.

Phenols

Phenol concentrations in Iowa streams are highly variable ranging from less than one part per billion to a maximum of 20 ppb. This variation occurs at given sampling points at different times of the year being a function of hydrologic flow, climatic conditions and other factors.

Experience indicates that the highest phenolic compound concentrations occur at the early stages of high flow conditions rather than at low flows. This phenomenon causes us to discount the significance of industrial or municipal input as this type source would tend to produce the highest phenol levels during low flow-low dilution conditions.

Aromatic ring compounds abound in nature and bacterial and fungal organisms are well known producers of hydroxylated ring metabolites. The probability is high that phenolic type compounds reactive to 4-aminaontipyrine could have a potential metabolic pathway resulting from such natural materials as wood tars, plant proteins, tannins, etc. Since Iowa waters at times are loaded with natural soluble organics due to soil surface leaching, the correlation with early stage run-off and elevated phenol concentrations is logical.

Iowa data bears this postulation out and some typical data illustrating phenol levels are delineated in tabular form attached.

The summary data (Table A-5) in the Federal report shows maximum phenol concentrations of 2 ppb did not change from above Sioux City to below the Omaha Council Bluffs area. These maximum levels which showed no relation to waste discharges are twice as high as the suggested FWPCA standard of 1 ppb and again indicate phenol concentrations resulting from natural degredation products often exceed the suggested standard.

> Iowa river cities using surface water showing phenol levels in the 10-20 range have not experienced taste and odor episodes attributable to phenol concentrations subsequent to normal chlorination for disinfection purposes.
>
> In view of the high and variable levels of phenolic compounds found in Iowa surface waters not traceable to industrial or municipal sources, it is the recommendation of the Iowa Water Pollution Commission that the maximum permissible concentration of phenolic type compounds be retained at 0.020 parts per million in all waters.
>
> There is no evidence or logic to suggest the pertinency of an individual standard for aquatic use specifically as most of our streams are multiple use including public water supply. While aquatic life is far less affected by phenols, it is realistic to provide the single standard at 0.020 parts per million on the basis of the most critical potential use.

TABLE 4

PHENOL CONCENTRATION IN IOWA STREAMS

DATE	RIVER	PHENOL ppb
1-24/25-67	Des Moines-Euclid	2
"	" Ipalco	18
"	" Ottumwa	3
"	Raccoon	2
"	Missouri-Co Bluffs	< 1
"	Cedar- Cedar Rapids	5
"	Iowa River-Iowa City	5
"	Mississippi-Davenport	11
"	" Burlington	11
"	" Keokuk	11
10/9/68	Mississippi-Upstream from Des Moines River	
	" Keokuk	1(Iowa Side)
	" "	2(Channel)
	" "	2(Illinois Side)
"	Des Moines-Keokuk	2
10/24/68	Mississippi-Lansing	1
2/12/69	" Davenport	9(481.3 channel)
"	" "	8(480.1 channel)
2/13/69	" Burlington	8(404.1 channel)
"	" "	12(400.3 channel)
2/8/69	" Keokuk	10(363.6 channel)
"	" "	9(359.1 channel)
"	Des Moines-Keokuk	4

Radioactivity

The original brief criteria on radioactive substances had been acceptable to the Federal Water Pollution Control Administration during earlier discussions. There was no indication of any disagreement on this criteria until the Federal reports were prepared for the conference, and there is no particular disagreement now. The State of Iowa has an adequate radioactivity sampling program and will accept the more detailed radiological limits now suggested by the FWPCA. The following limits on radioactive substances have now been adopted by the Iowa Water Pollution Control Commission:

> Gross beta activity (in the known absence of 90 strontium and alpha emitters) shall not exceed 1000 picocuries per liter.
>
> The concentration of 226 radium and 90 strontium shall not exceed 3 and 10 picocuries per liter respectively.
>
> The annual average concentration of specific radionuclides, other than 226 radium and 90 strontium, should not exceed 1/30 of the appropriate maximum permissible concentration for the 168 hour week as set forth by the International Commission on Radiological Protection and the National Committee on Radiation Protection.
>
> Because any human exposure to unnecessary ionizing radiation is undesirable, the concentrations of radioisotopes in natural waters should be maintained at the lowest practicable level.

E. SUMMARY OF ACCEPTABLE WATER QUALITY STANDARDS REVISIONS AND ADDITIONS.

The following are the various revisions or additions to the surface water quality criteria and plan of implementation which have been adopted by the Iowa Water Pollution Control Commission:

Section 1.2(455B) Surface water quality criteria

1.2(3)

a. Public Water Supply

(1) Bacteria: Numerical bacteriological limits of 2000 fecal coliforms per 100 ml for public water supply raw water sources will be applicable during the low flow periods when such bacteria can be demonstrated to be attributed to pollution by sewage.

(2) Radioactive Substances:

Gross beta activity (in the known absence of 90 strontium and alpha emitters) shall not exceed 1000 picocuries per liter.

The concentration of 226 radium and 90 strontium shall not exceed 3 and 10 picocuries per liter respectively.

The annual average concentration of specific radionuclides, other than 226 radium and 90 strontium, should not exceed 1/30 of the appropriate maximum permissible concentration for the 168 hour week as set forth by the International Commission on Radiological Protection and the National Committee on Radiation Protection.

Because any human exposure to unnecessary ionizing radiation is undesirable, the concentrations of radioisotopes in natural waters should be maintained at the lowest practicable level.

b. Aquatic life

(1) Warm water areas.

Temperature:

Mississippi River-Not to exceed an 89°F maximum temperature from the Minnesota border to the Wisconsin border and a 90°F maximum temperature from the Wisconsin border to the Missouri border nor a 5°F change from background or natural temperature in the Mississippi River.

Missouri River-Not to exceed a 90°F maximum daily temperature nor a 5°F change from background or natural temperature during the months of May through October and a 10°F change during the months of November through April.

Interior streams-Not to exceed a 93°F maximum temperature nor a maximum 10°F increase over background or natural temperature.

Heat should not be added to any water in such a manner that the rate of change exceeds 2°F per hour.

(2) Cold water areas.

Temperature:

Not to exceed a 70°F maximum temperature. The rate of change due to added heat shall not exceed 2°F per hour with a 5°F maximum increase from background temperature.

c. Recreation

(1) Bacteria:

Numerical bacteriological limits of 200 fecal coliforms per 100 ml for primary contact recreational waters will be applicable during low flow periods when such bacteria can be demonstrated to be attributable to pollution by sewage.

Non-degradation statement

Waters whose existing quality is better than the established standards as of the date on which such standards become effective will be maintained at high quality unless it has been affirmatively demonstrated to the State that a change is justifiable as a result of necessary economic or social development and will not preclude present and anticipated use of such waters. Any industrial, public or private project or development which would constitute a new source of pollution or an increased source of pollution to high quality waters will be required to provide the necessary degree of waste treatment to maintain high water quality. In implementing this policy, the Secretary of the Interior will be kept advised and will be provided with such information as he will need to discharge his responsibilities under the Federal Water Pollution Control Act, as amended.

R. J. Schliekelman

(See also Appendix A and B.)

MR. SCHLIEKELMAN: The purpose of the statement is to set out the State of Iowa's position on the matters of disagreement with the FWPCA. The Federal position is outlined in the report which was presented yesterday. We feel, however, that there has been considerable discussion of some aspects, such as turbidity, bacterial loading, nutrient loading, agricultural land runoff and other conditions which may not be entirely accurate. Some of these aspects do actually appear to discredit the water quality and the State's water pollution control efforts. In addition to that, some of these items are outside, really, the scope of the Iowa Water Pollution Commission control.

To the casual reader some of the discussion tends to create false impressions of widespread pollution and ineffective control. This statement, therefore, is an attempt to put the issues in context to clarify the Iowa position on matters actually in controversy and to present the positive side of the Iowa program.

I might get a little bit into the history of the Iowa water pollution control program from actually a long ways back.

The first Iowa water pollution control law was passed in 1923, and I think even at that time Iowa was considerably ahead of a lot of the other States as far as water pollution control program is concerned. At the time this law was passed we had nearly 200 municipal sewage treatment plants in operation in the State of Iowa.

In recognition of the fact that treatment plant construction is effective only if operation is efficient and competent, an operator training and voluntary certification program was implemented in 1952. In 1965 the Legislature passed and implemented a mandatory certification law, and Iowa is now one of 17 States which has such a mandatory certification law.

Also in 1949 the law at that time lifted a previous restriction so that effective in 1951 the Mississippi and Missouri River cities and towns were subjected to all provisions of the stream pollution control law which was in effect at that time.

On the Missouri River, Iowa is a member of the Missouri River Basin Health Council. They agreed in 1952 to participate in the adoption of a guide for water pollution control activities. The several States of the Council at that time agreed to a program for elimination of toxic substances and settleable solids, and treatment of industrial wastes as necessary to prevent deterioration of water quality.

In 1965 we did have the enactment of the present water pollution control law which did create the Iowa Water Pollution Control Commission. Since this law was passed, the Commission has adopted three regulations to aid in surveillance and enforcement. The first is a regulation relating to the general criteria of water quality standards, which makes mandatory the effective removal of settleable and floatable solids from municipal wastewater discharges.

The second regulation requires submission of monthly operation reports from treatment plants. By specifying the format and content, the department can actually evaluate the plant effectiveness and obtain an indication of the plant's effect on the receiving stream water quality.

Also a couple of years ago Iowa adopted what they call an Iowa--or rather we adopted a mail order

BOD program, which also has proven effective in surveillance of treatment plants. This program utilizes a technique for fixing samples in the field in preparation for a BOD determination in the State laboratory.

The third regulation, which has not yet received legislative approval, has been adopted by the Commission requiring control of feedlot runoff. Actually, at the present time feedlot pollution is being effectively controlled through the present enforcement provisions of the law.

Under various provisions in enforcement procedures, the Commission since its inception in 1965 has actually issued 114 consent orders for correction of pollution conditions.

Iowa is one of the large meat packing States in the Union, and the meat packing plants do constitute one of the largest potential sources of pollution. Every meat packing plant in the State has a treatment plant in operation or under construction, and this represents some three and one-half million population equivalent. We feel that some of the plants are getting really good removal, up to 98 and 99 percent BOD removal, and I think a lot of this has been due in part to the pioneering of the anaeboric/aerobic lagoon treatment process by the State of Iowa.

We think it is significant that Iowa does not have stream classification. We have all streams classified to the highest extent. Although the standards do specify recreation, fishing, and water supply uses, and the areas of applicability have been defined, minimum defined standards of high quality apply to all waters of the State.

In summary, Iowa has through the years recognized the need for clean water and continued its expansion of the program to meet needs. The regulatory agency has exercised its authority to abate pollution and to maintain and improve water quality, and municipalities and industries have complied with the requirements. The accomplishments shown by the record can be compared with the best in the Nation. Despite the adverse impressions created by the Federal report, and the Secretary's decision to except certain provisions of the standards, Iowa in the past and will in the future exercise its regulatory authority to the fullest extent.

R. J. Schliekelman

I might make a little comparison with some of the other States as far as the percent of treatment of urban population is concerned. The State of California at the present time has about 4.8 million of its urban population without treatment out of a total urban population of 17 million. The State of Florida has 2.2 million urban population without treatment as compared with 4.8 million total urban population. The State of Maine has 412,000 population without treatment out of a total population of 509,000.

Now we will try to get a little bit into the discussion of the summary and conclusions made in the Federal report. We feel that some of these items do deserve comment and they will be discussed to some extent. We have a section here which we have entitled "Agricultural **Runoff Effects**."

Items E, G and K of the Federal report deal generally with agricultural runoff effects. While of interest, this particular aspect is actually outside the scope of controllable standards, and the manner of the statements as they have been presented in the report could lead the less than totally informed reader to unwarranted conclusions.

To take up section E, this is a quote from the report:

"It is estimated that at least 3,300,000 cattle and calves and 6,100,000 hogs and pigs are on farms. These animal wastes have a population equivalent of 65,000,000 and can cause several conditions of stream degradation."

There is no particular problem from animal waste until such time as rainfall, snow melt or water passes through the feedlot dissolving material from the manure and carrying it to the stream. Since the load of dissolved and suspended matter carried by the water to the stream is actually only a fraction of that on the feedlot, therefore the 65,000,000 **population equivalant of animal** waste on the feedlot should not be interpreted as a load on the stream.

There is another comment quoted:

"Sediment from uncontrolled runoff is a major pollutant of the Missouri River."

This reference to low turbidity water discharged from Gavins Point compared to the **turbidity** conditions through Iowa is understandable. The effect of settling of sediment in the pool above the dam at Gavins Point is not available in the lower reaches. Again this aspect is outside of controllable standards and is not an issue at the present time.

Item K from the Federal report. This is quoted as follows:

"High densities of bacteria and high concentrations of nitrogen and phosphorus are found in Iowa tributaries to the Missouri River, especially during periods of stormwater runoff."

This statement could be expanded to include the agricultural land and streams in all States. Furthermore, while some control can be imposed, the bacteria, nitrogen and phosphorus in stormwater runoff can never be fully abated. Stormwater runoff effects negate at least in part the desirable effect of continuous disinfection of treatment effluents.

We will have a few comments also on recreational uses. This is covered in one section, Item P of the Federal report. This is quoted as follows:

"Recreational uses on the main stream include boating, water skiing, swimming and wading. These activities are directly affected by the presence of floating material and grease balls, high bacterial densities, dissolved organics and turbidity. Samples of water taken in the survey had as high as 2,000 bacteria per drop."

Another quote from the report states:

"Fouling of fish nets and lines with grease is common below major municipal and industrial waste outlets. Similarly, boat hulls of recreational watercraft are fouled with grease and scum."

The position of the Iowa Water Pollution Control Commission has been that we have not designated the main stem of the Missouri as a recreation stream involving whole-body contact, namely swimming and water skiing. The Iowa Health Department also has for many years recommended Iowa streams not be used for this purpose because of the injury and drowning hazards involved. Actually, section IV of the Federal report contains the following statements which appear to bear out this position: The second paragraph on page IV-7 of the report is quoted as follows:

R. J. Schliekelman

"Present recreation use along the Missouri River in Iowa has not met its potential for the amount of land and water acreage involved. While being light, however, it appears that most recreation activities are participated in with sightseeing, boating, picnicking and fishing as the most popular."

We have another quote that says as follows:

"Water skiing, surprisingly, is enjoyed even though the river contains a high silt load. Swimming is not considered a common activity due in large measure to the dangerous water conditions and high turbidity."

This is quoted from the Federal report.

Another quote is as follows:

"It can be expected that use on the waters of the Missouri will principally be in the form of fishing and boating, and on the adjoining lands in the form of sightseeing, picnicking, hiking, driving and walking for pleasure, and in historical interpretation."

These are the end of the quotes.

From this we believe that it would appear that there is general agreement that the value of the

Missouri River for whole body sports is dictated principally by factors other than controllable water quality criteria and that maintenance of the general criteria and the criteria for public water supply use and aquatic life should adequately protect recreational uses.

We also wish to comment on some of the discussion regarding the grease balls, grease and other problems mentioned in items P and S of the Federal report. The discharges which would be most suspected of containing large amounts of grease would be the Iowa Beef Packers discharge at Dakota City, Nebraska, the municipal sewage treatment plant at Sioux City, Iowa, and the city of Omaha, Nebraska. Grease is discussed on page A-26 of the Federal report, and this discussion is quoted as follows:

"The concentration of grease from the daily composite from the Monroe Street and South Omaha sewers averaged 299 milligrams per liter during the October 1968 survey. The actual amount of grease reaching the Missouri River following a privately-operated recovery operation at the Monroe Street sewer was not determined."

Another quote continues as follows:

R. J. Schliekelman

"The grease concentration in the effluent from the Sioux City, Iowa, sewage treatment plant during the October 1968 survey averaged 17 milligrams per liter. The amount of grease removed through the sewage treatment plant was not determined."

That is the end of the quote.

Actually, the amount of grease discharged to the Monroe Street sewer in Omaha can be computed to be about 50 tons per day. In comparison, the 17 milligrams of grease found in the Sioux City effluent is not significant. The 17 milligrams of grease amounts to a little over 1 ton in the Sioux City effluent as compared to the 50 tons being discharged to the Omaha Monroe Street sewer.

Studies conducted by the Public Health Service, I believe, in 1965 at the time of reconvened session of the Omaha conference on the Missouri River also came up with the conclusion that there were about 100,000 pounds of grease discharged from the Omaha area. That is, I think, really from the Omaha sewers, not the Omaha area.

The Federal report also speaks of grease balls as big as oranges, but does not say where these were observed. Nor does it contain information concerning the grease content of the Iowa Beef Packers' effluent at Dakota City, Nebraska. This particular effluent is located about four miles downstream from the effluent of the Sioux City sewage treatment plant. We don't want to appear to be actually putting the Iowa Beef Packers Company in a bad light. Our relations actually in the State of Iowa have been very good, they have had a very good record on the two plants that they have at Denison, Iowa, and also Fort Dodge, Iowa, so actually they are doing a good job as far as the Iowa side of the stream is concerned. But we do not have information as to what is being done at Dakota City.

The Iowa Department of Health has information that the State of Nebraska has permitted Iowa Beef Packers at Dakota City to discharge wastes which may be over 200,000 population equivalent compared to 195,000 population equivalent listed in the Federal report for the city of Sioux City sewage treatment plant effluent. Grease removals in the Sioux City plant we feel would be much more effective than the Iowa Beef Packers industrial unit, so that the grease observation should probably not be attributed to the city of Sioux City.

We have a section on water quality effects which will be discussed further by Dr. Gakstatter of the State Hygienic Laboratory.

We also have a section on fish tainting which will be discussed by Mr. Harry Harrison of the Iowa State Conservation Commission.

We do have a comment regarding treatment requirements in other States as described in item T of the Federal report. This states as follows:

"Every State which borders the Missouri River, except for Iowa, has adopted as part of its standards a minimum requirement for secondary treatment or its equivalent for wastes discharged into the Missouri River."

This department has been informed by the State of Kansas that Kansas, which borders on the Missouri River, has not agreed to a blanket requirement for secondary treatment without such need being demonstrated. Kansas standards have not been approved by the Secretary of the Interior.

We have a section in our statement regarding the Federal Water Pollution Control Administration biological study which will also be discussed by Dr. Jack Gakstatter of the State Hygienic Laboratory.

In our next section we wish to comment on some of the recommendations that have been made by the Department of the Interior for the Missouri River Basin. The Iowa position on each of the recommendations is outlined in the same order as they appear in the Federal report.

Secondary treatment.

The Department of Interior blanket requirement for secondary treatment of all municipal and biodegradable wastes cannot be justified on the basis of congressional intent, nor can such a requirement be adopted by the Iowa Water Pollution Control Commission under present Iowa statutory authority.

The Commission, under Iowa law, has no direct statutory authority to establish or enforce effluent standards. There is no authority to specify type of treatment except that based on water quality criteria of the receiving stream. Treatment can be regulated only to the extent that it will produce an effluent that will protect the stream and meet the water quality criteria.

On the basis of stream water quality requirements, secondary treatment will be needed and, therefore, has or will be required for all but four or five of the 490 municipal sewage treatment plants located on interior streams. However, the Mississippi and Missouri Rivers have very high assimilative capacity, and, therefore, we did not feel that there should be treatment applied without a necessity being actually demonstrated. Extensive studies made during the 1950's on the Mississippi River and also a 1950 pollution investigation on the Missouri River demonstrated a relatively low effect of even untreated wastes on these border streams. However, as a result of water pollution investigations and voluntary compliance, all cities and towns, with the exception of the small Mississippi River towns of Marquette and Lansing, completed primary or secondary treatment during the 1950 to 1966 period.

The dissolved oxygen values actually presented in figure A-2 of the Federal report indicate no significant decrease in dissolved oxygen during the

October 1968 survey period, and there was an actual increase progressing downstream to the Omaha area during the January 1969 period.

The principal oxygen demanding sources now existing in the Sioux City area are the primary treated effluent of the city of Sioux City and the relatively untreated waste from the Iowa Beef Packers plant at Dakota City, Nebraska. As determined from samples collected by FWPCA and from composite plant operation reports submitted to the State Department of Health, the Sioux City effluent has a population equivalent waste loading in the range of 200,000. No similar plant composites were collected by the FWPCA from the effluent of the Iowa Beef Packers plant at Dakota City, but actually the information available does indicate that the Iowa Beef Packers plant may be discharging a load of approximately 200,000 to the Missouri River.

The oxygen demanding wastes for Omaha as given on page IV-24 of the Federal report is 1.8 hundred thousand, which is 46 times that of the city of Council Bluffs. Some oxygen depreciation was created by the discharge of this primarily untreated effluent in the Omaha area.

These water quality studies which have been made show that there has been little significant reduction of dissolved oxygen levels below sources of oxygen demanding wastes, even prior to primary treatment. This is a fortunate condition, and actually fairs well as compared with some of the other major streams where secondary treatment is needed. For instance, the 1968 report of the Ohio River Valley Water Sanitation Commission showed dissolved oxygen levels of below 4 parts per million occurred about 33 percent of the time in the lower reaches of the Ohio River. Likewise, the lower reaches of the Delaware River have had very low oxygen levels and hundreds of millions of dollars must be expended by communities and industries along this stream for secondary treatment simply to maintain three and a half parts per million of dissolved oxygen.

Using cost figures published in the Journal of the Water Pollution Control Federation, it has been estimated that construction of secondary treatment facilities for all waste discharges to the Missouri and

Mississippi Rivers would cost over 25 million dollars. Furthermore, according to figures published in the 1969 Federal Water Pollution Control Report, the cost of maintenance and operation of these secondary plants would be approximately 1.7 million dollars per year more than for the existing primary treatment.

The Iowa Water Pollution Control Commission has had no hesitancy to require secondary treatment of any waste discharge to either the Mississippi or Missouri Rivers, when the need to satisfy water quality requirements is shown. However, it is the Iowa position that a need for uniform secondary treatment of all waste discharges has not been shown and that there is no scientific reason to believe that secondary treatment of every waste discharge on the border streams will enhance the water quality.

Some degradation of water quality is evident below the Omaha-Council Bluffs area due to the low percentage of wastes actually receiving treatment during this particular period. It is, therefore, suggested that additional water quality studies be conducted following completion of the meat packing plant pretreatment facilities to permit evaluation of Missouri River water quality when receiving primary treated effluents from the city of Omaha.

The next section is on disinfection.

At a meeting on February 9, 1968, with Robert S. Burd, Director of the Federal Water Pollution Control Administration Water Quality Standards Staff, Iowa agreed to adopt definite numerical **bacteriological limits** compatible with the National Technical Advisory Committee recommendations for waters used for public water supplies and primary contact recreation, namely swimming and water skiing. The Department of the Interior further agreed that the standards would recognize these values as applying during dry weather, but will state that all reasonable efforts will be made to reduce bacteria concentration increases during periods of stormwater runoff.

The Iowa Water Pollution Control Commission at its April 4, 1968, meeting adopted a motion accepting these provisions, and the Iowa water quality standards have been revised to include the following numerical bacteriological limits:

Public water supply. Numerical bacteriological limits of 2,000 fecal coliforms per 100 ml for public water supply raw water sources will be applicable during low flow periods when such bacteria can be demonstrated to be attributed to pollution by sewage.

The same terminology applies to recreation use, except the bacteriological limit is specified as 200 fecal coliforms per 100 ml.

The water quality criteria and plan for implementation and enforcement for the surface waters of Iowa was adopted by the Iowa Water Pollution Control Commission in May 1967 and this plan did designate the surface waters to be protected for public water supply use as well as the recreational use areas on lakes, impoundments and rivers. The treatment needs in the plan specified coliform reduction or effluent disinfection by the municipalities to protect this use during the recreational season. Information obtained from other State agencies and information at the public water quality hearings were used to designate these recreational areas, and the plan does specify for interior municipalities chlorination where necessary to protect these uses.

The State of Iowa therefore feels that

acceptable bacteriological criteria have been established for interstate waters in Iowa. These criteria are compatible with criteria from adjoining States which have been established for public water supply and recreation. These other States also generally specify or take into consideration the effective land runoff and are also applied when necessary to protect specific water uses.

Land runoff does contribute high bacteriological densities, and bacterial studies in the State of Iowa and elsewhere have shown that commonly acceptable coliform levels have been greatly exceeded even in the absence of wastes attributable to human sources. The following is quoted from a long term study of total coliforms in the Iowa River at Iowa City, Iowa:

"If a stream contains coliform organisms that are of domestic sewage origin, one might expect the MPN to vary inversely with the dilution capacity of the stream. High MPN values would be expected during the dry seasons."

Quoting further:

"In the Iowa River, increases in stream flow are accompanied by increases in both turbidity and coliform organisms. This pattern has been apparent over the entire 1950-1964 period and is true whether one examines daily or monthly average data.

"Apparently, large numbers of coliform organisms are carried into the river after each rainfull and snow melt. The increase in turbidity also indicates the agricultural land adjacent to the river as the source of many of these coliform organisms. Storm sewer overflow is not considered a significant factor, because the nearest upstream city is 30 miles above Iowa City and above the impoundment.

"In view of the apparently high numbers of nonfecal coliform organisms and the correlation of high coliform densities with high flow, one might question the significance of such MPN data as related to the bacterial safety of the Iowa River water. Does a high MPN, especially a high monthly average which may be caused by runoff from a single rainfall, mean that this water is an undesirable source? Probably not."

We have made some estimates on the cost of continuous disinfection or chlorination of municipal treatment plant effluents of 77 municipalities which are located on interstate streams in Iowa. It is estimated that the construction and equipment costs for these 77 municipalities,which are located on both the Missouri and Mississippi Rivers as well as interstate streams, would cost approximately 2.4 million dollars and the annual chlorine cost would be in the neighborhood of about $850,000.

The expenditure annually of these large sums of money required for year-round disinfection of municipal and industrial wastes as recommended by FWPCA will not improve the bacteriological quality of interstate waters during periods of runoff, and these are the periods when high bacterial levels have been found. The Iowa Water Pollution Control Commission has agreed to disinfection of these waste discharges,ones that can be expected to affect recreational or public water supply uses.

The Missouri River is considered as being unsuitable for whole body contact recreation, and this precludes the need for disinfection to protect this particular use. The one possible need for disinfection would be in the Sioux City area to protect downstream water supplies. However, that need, as demonstrated by the Federal Water Pollution Control Administration water quality report, appears to be rather borderline and the study covered a relatively brief period of time. Therefore, before definitely establishing a compliance requirement and making the large expenditures that will be required, additional study should be undertaken to more accurately determine the coliform densities and sources.

Temperature requirements will be covered rather briefly by Mr. Harrison of the State Conservation Commission.

We apparently are in agreement on the nondegradation clause and this will not be covered this morning.

Phenols were also discussed yesterday by Dr. Morris. I don't know if Dr. Gakstatter will comment a little bit more fully on this or not this morning.

Radioactivity was also described yesterday, and I think our position is that we are acceptable to the Federal requirements on this particular phase of the recommendations.

I believe that is our summary, then, of

the position.

MR. STEIN: Do you want to introduce your next speaker?

MR. SCHLIEKELMAN: Dr. Gakstatter, would you want to present your portion of the statement?

STATEMENT BY JACK GAKSTATTER
PRINCIPAL LIMNOLOGIST, STATE HYGIENIC LABORATORY, DES MOINES, IOWA

DR. GAKSTATTER: Mr. Chairman, ladies and gentlemen.

My name is Jack Gakstatter and I am Principal Limnologist for the Des Moines Branch of the State Hygienic Laboratory. I would like to begin with some comments of the FWPCA biological study.

The manner in which the biological data was presented did not deviate from the rest of the Federal report. Conclusions were not objective and pertinent facts were buried which tended to create the illusion that Iowa is a major polluter of the Missouri River.

The FWPCA summary, and this in part M

on page II-3, regarding the biological study states the following, and I quote:

"Biological investigations revealed predominately clean water organisms and associated aquatic life above Sioux City. However a consistent increase in pollution tolerant organisms and biota were observed in many stretches of the river between Sioux City and St. Joseph."

This statement leads one to believe that all is well above Sioux City, whereas the Missouri downstream from Sioux City is polluted. If the data, and this is on Table B-2 of the Federal report, is examined objectively, it is obvious that this statement is misleading.

The fact is that the study showed little difference in the biological quality between station 736 and 730--these are river mileages, station numbers are M-52 and M-50--above the Sioux City sewage treatment plant discharge, whereas every sample taken in the first 74 miles below the Sioux City discharge definitely demonstrated a biological fauna which was superior in quality to that observed upstream from Sioux City.

stoneflies, which are noted for being extremely pollution intolerant, were found at three stations downstream from Sioux City, while data indicate that no stoneflies were found above Sioux City. Likewise there was a greater diversity of mayflies in the first 74 miles below the Sioux City discharge than there was above Sioux City. Mayflies are also pollution intolerant organisms which require high water quality. The FWPCA data, also on Table B-2, demonstrate that pollution intolerant forms were present in greater diversity in the first 74 miles below the Sioux City discharge than above it. This is not a claim that the treated waste discharge from Sioux City enhances biological quality in the Missouri River, but merely points out that the biological quality was not deteriorated at these stations by the Sioux City discharge.

It is stated in the Federal report, page B-1, that severe degradation of the bottom associated organisms occurred for 54 miles downstream from the Omaha-Council Bluffs area, and that floating solids, this refers to grease and chunks of animal fat, were observed for 166 miles downstream.

It is interesting to compare the waste contribution of Omaha, Nebraska, and Council Bluffs, Iowa.

Dr. J. Gakstatter

This can be readily done by a few simple calculations using the data given on page IV-24 of the Federal report. Omaha, Nebraska, discharges 1,801,640 population equivalents to the river, or 46 times as much as the Council Bluffs 39,000 population equivalent discharge. Omaha's waste load to the river thus exceeds the sum total waste load discharged by the 20 Iowa municipalities (including industries) which are located on the Mississippi River.

Eighty-eight percent of Omaha's raw waste load receives no treatment or, in other words, is discharged directly to the Missouri River. All of the Council Bluffs waste receives primary treatment.

It is therefore not at all surprising that the Missouri is biologically degraded for 54 miles below Omaha, nor is it surprising that grease balls are found as far as 166 miles downstream. However, these conditions can hardly be attributed to Council Bulffs.

Now I have some comments regarding parts L and O in the Federal summary, which are found on page II-3. Part L states, and I quote:

"Survey results from the main stream of the Missouri River in Iowa identified adverse changes in water quality. Turbidity increased fourfold in the length of reach surveyed and cyanide and phenols were found."

It is true that phenols were found in the Missouri River. However, the Federal report failed to mention in the summary that the maximum observed phenol concentrations in table number A-5 did not change from station M-52, which is located above Sioux City, and station M-38, which is located below the Omaha-Council Bluffs area. These maximum levels, which showed no relation to waste discharges, were two parts per billion, which is twice as high as the suggested FWPCA standard one part per billion. These data further substantiate Iowa's position that the phenol concentrations resulting from natural degradation products often exceeded the FWPCA standard of one part per billion, and that this standard is therefore unreasonable.

During the January 1969 FWPCA survey, turbidity values were shown to decrease from 19 units above Sioux City to 8 units below the Omaha-Council Bluffs area. During this period stormwater runoff was minimal and these data show that the sewage treatment plant discharges had no effect on the turbidity of the

Missouri River. High turbidity in the Missouri is caused exclusively by land drainage and that subject is not relevant to this conference.

Cyanide concentrations up to 15.2 parts per billion were measured in the Missouri River. These concentrations given in Table A-5 of the Federal report bear no apparent relationship to municipal or industrial discharges. 12.2 parts per billion of cyanide were found above Sioux City while less than one part per billion was found below the Omaha-Council Bluffs area. In no case was the Iowa aquatic life standard of 25 parts per billion of cyanide violated.

Part O of the report states, and I quote:

"Public water uses relying on the Missouri River as a source of supply report problems associated with turbidity, ammonia, coagulation, taste and odors."

These are common problems of most surface water treatment plants, whether or not being affected by upstream waste discharges. We have already established that turbidity problems in the Missouri are not caused by waste discharges but by land runoff over which we have no control.

Dr. J. Gakstatter

Sewage treatment plants are designed to eliminate settleable materials and organic carbon, not ammonia. Waste effluents from secondary treatment plants contain concentrations of ammonia which are many times greater than concentrations in the average receiving waters. Nevertheless, increased ammonia concentrations in the Missouri and in other Iowa streams are generally the result of agricultural land drainage and not sewage treatment plant discharges. This is substantiated by the fact that 85 percent of the Missouri River stations had greater ammonia concentrations during the runoff period than during the period of normal flow, and this could be verified in Table A-3 of the FWPCA report.

Finally, in conclusion, it has been widely recognized by Iowa that taste and odor problems frequently are encountered during periods of surface runoff, particularly in late winter and spring. However, again this is something which isn't related to sewage treatment plant discharges.

That is the end of my statement.

MR. STEIN: Thank you.

Who is next from Iowa?

H. M. Harrison

MR. BUCKMASTER: Mr. Harrison

STATEMENT BY HARRY M. HARRISON
IOWA STATE CONSERVATION COMMISSION
DES MOINES, IOWA

MR. HARRISON: My name is Harry M. Harrison. I work for the Iowa State Conservation Commission. I have been employed by that agency for 23 years. Seventeen years of that time was spent in the field as a field biologist.

I would like to say to begin with, ladies and gentlemen, that I am very, very happy to be here this morning. My interest in wildlife and fisheries goes way back to my youth, and in this time I have spent a lot of time in the rivers of this State, much of it without the protection of a bathing suit. After listening to Mr. Geldreich's report yesterday, and considering the exposure that I have had to pathogens, added to the good will that I heaped on myself over at Davenport last week, I should say that I am happy to be any place today.

(Laughter.)

H. M. Harrison

I heard a talk Monday of this week by a reputable sanitarian, and he mentioned that the big problems in this day are really caused by very little things, and then he went on to mention the ovum, the atom, a little bit of skin pigment, and to that list I would like to add one more thing, pathogenic organisms in flowing water.

Over at Davenport I began my remarks with words to the effect that I was accusing FWPCA of practicing legerdemain with biological facts and statistics to create some illusions that were misleading, confusing, had very little basis in fact, and not germane to the conference. This about sums up my impression of the present conference.

With that, I would like to wade in--excuse me, discuss with you; I don't want to wade into anything any more (laughter)--discuss with you some of the discussion here that we had with temperature.

I am not sure that the people that discussed temperature were familiar with the facts as they are in this day. We have no dispute with FWPCA on temperatures in the Missouri River. This was settled before the time of the conference. We have no dispute with the maximum temperature. This was decided before the conference. The dispute that we have involves whether or not we should permit or whether or not a difference or an increase in 5 degrees or 10 degrees will protect aquatic life in Iowa.

It is my considered opinion that 10 degrees will protect aquatic life. I would, therefore, point out again that the other discussions are really not germane, but there is one thing that I would like to call attention to. The data was cited that the preferred temperature of smallmouth bass was 82.4, for the yellow perch it was 75.6 and for the green sunfish it was 81.2. I guess I kind of favor the green sunfish. My preferred temperature is 81.3. How about that?

(Laughter.)

MR. STEIN: Mine is 96.8.

(Laughter.)

MR. HARRISON: Now there have been some other illusions that our fisheries populations in Iowa are suffering from pollution and probably in jeopardy, and I would like to clarify some of my remarks or some of the things that I think were misinterpreted over at Davenport by citing a little history.

Back in 1886 to 1887 a gentleman by the name of Seth Meek traveled through Iowa and collected fishes at various places in the State of Iowa. I have his publication and have looked at it many, many times. In 1940 Dr. Reeve Bailey, a fishery scientist of great renown, retraced Mr. Meek's steps and collected in the same area. I followed Dr. Bailey with my collections in 1950, and I have people assigned to me today that will do this work again in 1969 and 1970. So we have some idea of what the fisheries picture is in the whole State of Iowa.

I might point out that my own collections in the 1950's, 1951 and 1952, amounted to about 1,000 collections in various places in the State of Iowa.

We know pretty well what the distribution by species is, and some of the facts that were stated here yesterday were facts, but they were not complete. We know, for instance, that in the Missouri side of the State of Iowa that there are probably in the order of 75 different kinds of fish. In the whole State there are

140. It depends upon the taxonomist how they want to split them up. It may be 141 or 142, but to come to some of the differences you have to count the number of scales that go around the body and if it is 13 it is one fish and if it is 14 it is another. I could never figure out myself what difference that made to anything except another fish of the same kind.

But I did point out over at Davenport that this was a channel catfish and carp State. I assumed that the people in the audience knew that I was referring to the species of fish that are of importance to the Iowa angler. The Iowa angler doesn't care anything about a brassy minnow or a golden shiner. These are of interest only to me and a few other people.

Dr. Tarzwell yesterday made a statement, and I don't think that we can really argue with it too much, that evolution has set the stage for the present fish populations. To a degree this is true. However, the fish populations that were in Iowa at the turn of the century must have received a shock when the white man started plowing the ground, straightening the rivers, and so forth, and although evolution may have set the scene, the fish populations that exist in Iowa today are here because of habitat and habitat alone.

The habitat in western Iowa has been destroyed, particularly in the Missouri River, by channeling, straightening, and so forth. We do not have a species, to my knowledge, in our State that is adapted to life in the Missouri River. Now, that does not say that some fish don't get by and that some fish do not reach fair numbers there. But the Missouri River in this day is a millrace. Now, there may be a fish some place in the world, a species, that we could import and put into the Missouri River that would make a good species for that river. I don't know what it is. If anybody does, why, we would be glad to know about it.

The streams in southwestern Iowa, starting with the lower reaches of the Little Sioux, the Maple River, the Boyer, Nishnabotna, the Nodaway, the Tarkio, and other streams that were named, have all been straightened between--well, before 1920. Fish populations in those areas are really not too good.

Now, we do have good fish populations in some of our artificial impoundsments and some of the other streams in the slope that drains to the Missouri River. I would call your attention to some of the work that is carried on by my department on the Little Sioux River. This is considered one of the better catfish streams in the United States. We have done life history studies out there on the channel catfish, population estimates, and so forth, and in some of our tagging experiments one of our biologists was able to capture about 5,000 channel catfish one summer, tag those fish and release them to study their movements.

Our fish hatchery that specializes in the production of channel catfish goes to the Missouri River or did for three years in a row to get the brood fish for the hatchery. They take about 1,000 brood fish per year from the river--they took these out of about a three-mile stretch of the river--to our hatchery to propagate channel catfish. I think this indicates something of the quality of the fish there that they could go in and take brood fish numbering nearly a thousand out of perhaps three miles of stream.

In another study that we conducted over there with respect to movement, we transported channel catfish from one area to another to see what would happen to them. In this project we were able to capture below a little stabilizer, which is another way of saying a low head dam, I guess, 10,000 channel catfish in less than a month's time. We moved those fish upstream in the Maple River to a little town of Ida Grove and released them to see what would happen. It might be of interest to you to know that the returns that we got were right back to where we picked them up in the first place, and it points out the fact that habitat is very important in **fish** life. They just didn't have the habitat up there where we stocked them, so they turned on their tails and returned to where they could find habitat.

There has been some thought, I think, or some illusions that secondary treatment might enhance fishery populations in western Iowa. I doubt very seriously that secondary treatment would do anything for the fish populations out there. Again you have the problem of habitat and it just won't get the job done.

I scribbled these notes down this morning and I want to make sure that I get everything.

I would like now to go to the discussion on commercial fisheries. Some mention was made about the catches of 1901 as compared with 1969. I don't believe this can be a valid comparison for a couple of reasons. We have had lots of changes since 1901 to 1969.

I would also point out to you that the catch statistics reported upon are collected by people that work for me, and the reason that we collect these statistics is because the code of Iowa requires us to. We have absolutely no confidence in the data that we get, and the reason is that commercial fishermen just do not report their catches. They operate out of their hind pocket, and if they can pick up $10 here and $10 there and do not have to report it as an income, why, that is just a little more for them.

To offer a simple answer to a complex question, I discussed this last week and I don't think there is such a thing as a simple answer to a complex question. It has been suggested that pollution is the reason for the drop in the catch of commercial fish. I submit another simple answer now. I think that the reduction in commercial fisheries catch in the Missouri River is inversely proportional to the income tax schedules.

H. M. Harrison

Taste and odors. I am not aware that we have a real significant problem with taste and odors in fish populations in the Missouri River, and I do not wish to discount the testimony that was offered here yesterday. Some gentleman named two fishermen, I believe, that had to throw away fish because of taste and odor problems. I can understand and believe this, and I am sure that it does happen from time to time. However, if taste and odors was a very, very significant problem in the fish flesh, I am sure that I would be aware of this. This sort of thing comes directly to my desk, and in the time that I have been in the Des Moines office, five and a half years, I don't believe that I have ever had a complaint, at least a written complaint, of the problem of taste and odors in fishes from the Missouri River.

Our department is also concerned somewhat with water-based recreation, not my department in particular, but our Commission, and I would like to call your attention to one other thing that has been touched on by Mr. Schliekelman. I don't believe that if you had distilled water running down the Missouri River it would be much of a place for outdoor recreation. The Missouri River is a hazardous body of water, and most certainly I wouldn't put my small children out there with a pair of water wings and tell them to go swimming. It just doesn't lend itself to this type of recreation. We will hope that some things that the Corps of Army Engineers have in mind will become a reality some day and we will have some impounded waters beside the Missouri River, and this is where we will send our people to water ski and swim, and so forth.

In closing, I would like to repeat pretty much something that I said over at Davenport and point out to those of you who were not over there last week that I am not a member of the Iowa Water Pollution Control Commission. I have had the privilege to keep a watchful eye on them to see what they are doing, and I have come to some conclusions about them that I think everybody ought to be aware of.

This is not a troop of boy scouts nor is it a fraternity of do-gooders. These are dedicated men, they come from a broad spectrum of our society, they are competent and they are aggressive. I have seen them take on many, many problems of pollution in the State of Iowa and work them out and correct the situation.

I would like to mention something about the competence and dedication of these men. You heard Dr. Morris yesterday. He is a very, very fine scientist. The State of Iowa employs him to head up their State Hygienic Laboratory.

This is no small responsible job.

Mr. Buckmaster is a successful businessman, an attorney, and he has taken a lot of his time to serve on this board. And for those of you that are concerned about conservation, I don't think that Mr. Buckmaster really got into pollution first and foremost because of pollution but because he was a smallmouth bass fisherman and he thought maybe something is happening to the waters of Iowa that he could correct.

These other gentlemen represent State agencies. They head up State agencies. They are successful farmers and businessmen. They represent cities and towns, and so this organization is taking care of pollution in Iowa.

Now, if the Great White Father in Washington isn't resting easy because he thinks the people in Iowa are wallowing in some squalor out here, you people when you go back tell them it isn't so, that these people take care of pollution in Iowa and I am sure we will all get along fine.

Thank you.

MR. STEIN: Thank you.

Is there anyone else from Iowa?

MR. BUCKMASTER: I might make a few remarks.

MR. STEIN: This is off the record.

(Off the record.)

STATEMENT BY ROBERT BUCKMASTER
CHAIRMAN, IOWA WATER POLLUTION CONTROL
COMMISSION, DES MOINES, IOWA

MR. BUCKMASTER: Mr. Stein, ladies and gentlemen.

I will jump around and cover some things and try to sum up Iowa's position. I always talk extemporaneously and sometimes worse, and I will probably do that on this occasion.

As I indicated in Davenport, Mr. Stein, I am deeply appreciative of the many courtesies that you as hearing examiner have extended to us in Iowa in presenting our views.

I am, as indicated there, deeply concerned about the public's reaction as a result of press stories--I am not critical of the press for this--of what it has done to Iowa's position nationally and in the State of Iowa. Some of us who worked most of our lives fighting pollution are now being attacked by former friends who are quoting from the New York Times, other periodicals and Iowa periodicals, saying that Iowa has the worst pollution situation in the United States. You know and I know it isn't true.

What this conference is about is a difference of opinion on the matter of attacking the problem, but it has resulted in putting us in the position of being the fellows with the black hats and you are the great white knights in Washington who are saving Iowa for posterity.

I think the people of Iowa should know, and I think some of them do, that we need no experts from any place to come out and lecture or instruct us on the values of the Mississippi and the Missouri River to this State.

Nor do we need any instruction on the values of wildlife or the necessity of maintaining our environment. Nor do we need any instruction on the fact that pollution destroys these values. We have no difference of opinion on this.

I think our record in Iowa, going back for a good many years, indicates that Iowans are deeply concerned about this and have expressed their concern in having adequate treatment of industrial and municipal wastes, and as your own figures show, Iowa leads all the States in the United States in the percentage of people having treatment of municipal wastes.

As a matter of fact, just so we get the record straight, your figures, in which you use the term urban population, show that there are approximately 1,500,000 people in Iowa who live in urban areas with sewage treatment. Now, I don't recall presently whether you use the figure 2,000 or 2,500 in defining an urban area. Your figures show that in every one of those we have treatment. We are the only State that has 100 percent treatment of urban sewage.

Let me add to that some other figures.

R. Buckmaster

We have a number of small towns in the State of Iowa that are under 2,000 or under 2,500, a large number. As a matter of fact, another 400,000 people in Iowa live in towns that are not called urban in your figures. Of those 400,000 people that live in cities and towns with sewers, and these go down to even a couple of hundred people, all but 13,000 have at the present time sewage treatment, and that other 13,000 that live in small towns are now under orders from our Commission to have treatment and are either in the planning process or the construction process.

So you can say that every town, every city, whatever population, in the State of Iowa, with the exception of the total of 13,000, now has treatment and they are now under construction, which gives us 100 percent. There is no other State that I know of that can boast this kind of a record.

Let me give you something else about that. Iowa has no State aid to cities, towns and municipalities for the construction of treatment plants. The only aid that they have received is the 30 percent from the Federal Government, and I know of small towns in Iowa who have voted bonded indebtedness in the area of $2,000 per home in order to have treatment, and many of them run in the area of $900 to $1,200 per home.

Yes, I am a little emotional that we are selected, Iowa, as the culprits and when we have been given national and local publicity so the people think we are not doing the job in Iowa.

I don't want to give the impression that we don't have problems. Some plants are not properly operated, some need additions, some need new plants. But we understand this. It will be taken care of. And I don't mean to imply that we don't have problems on both the Mississippi and on the Missouri River, although I think the Missouri is minor compared to our others. But if we are talking about the main thrust, I feel very proud of the job that Iowa has done and is doing.

Let me jump around to a couple of other things. One thing I want to mention. Mrs. Koerber yesterday from the League of Women Voters, I am sorry she is not here today, asked a very penetrating question, and she is entitled to an answer. As a matter of fact, I thought she asked a more penetrating question and made a more penetrating point than all the staffs of Chicago and Kansas City and Washington with the engineers, the sanitation people, the scientists and the lawyers. In fact she, I think, deserves an answer.

Her point was, in looking at our total program for water quality criteria and its implementation,what is the provision under General Criteria. Now, we said:

"In general, those small intermittent streams experiencing low or zero flows or which cannot under natural conditions support a permanent fish population, will have their quality governed by the General Criteria. It is the intent of the General Criteria to protect the water quality in these areas for the legitimate uses to which they are presently being used."

I don't believe in her statement she gave the first sentence that starts out what streams we are talking about.

"Legitimate uses in this category are those such as: irrigation, livestock watering, wildlife propagation, etc. To protect these uses on low flow streams, the wastes will be given the highest practicable degree of treatment without respect to dilution in order to prevent the development of nuisance or health problems below the discharge. The requirements are such that the effluent will be suitable for limited downstream use. Treatment less than secondary will not be accepted unless it can be shown that the legitimate uses can be protected with a lesser degree of treatment."

Her point was if you can require in that case secondary treatment, and the proof has to be on the other people (it isn't required), why can't you do the same thing generally. And on the face of it this is a legitimate thrust.

But what we were covering there and which is clear, I think, to anybody that has gone into this, we were talking about streams, and there are about--I think out of 510 treatment plants in the State of Iowa there are about 160 treatment plants on areas that can support warm-water aquatic life. These are the larger streams.

Now, the balance of these are on intermittent streams, and at low flow there may not be any water in them at all. In fact, the only flow may be the sewage effluent. And, therefore, it was our judgment that on the basis of nuisance conditions, as a matter of public health, on that type of stream we could require secondary treatment to meet the criteria of nuisance and health requirements, not to support because they couldn't meet the water quality standards no matter what they did. It doesn't change our basic jurisdictional requirement that treatment has to be such as to protect the water quality criteria.

Again, just to summarize, as I understand the Secretary of the Interior's order of January which approved our standards, which was 99-99/100th of what we did and accepted certain areas, I just want to go back again and get it focused what we are talking about here as I understand it. I won't get into radioactive, phenols, and so on. We all understand that.

There are two areas in addition to the secondary treatment matter. One is the area of disinfection. We stated our position in Davenport, state it again. On those interior streams that we are talking about in this hearing, and regardless of interstate or intrastate, we will require disinfection by chlorine the year round where it is used for public water supply.

In those areas defined as recreational area we will do it seasonal.

Again because there are some people here locally that didn't hear the presentation at Davenport, it is the judgment of the Iowa Water Pollution Control Commission that in the months other than May through October there is no water contact sport in Iowa. Again as I stated in Davenport, if you will check with the Federal meteorologist you will find that in those months in Iowa we do very little swimming, water skiing or anything else that has to do with body contact in water.

This is not Florida, and as you indicated, consistency is the hobgoblin of mediocre minds. The way I heard it was it is the hobgoblin of little minds, but I guess we are talking about the same thing. Consistency in this, it seems to me, is a hobgoblin and the conditions are different. We do not propose to protect for recreational uses while the streams are frozen.

Now, on the Missouri River on disinfection we have a different position. We are not convinced that disinfection is required on the Missouri River. We don't think that your studies show it, because they are non-selective. I don't want to get into this whole thicket, other than I think that if there are means, as your experts indicate, to differentiate and determine the source of these, then why in the hell don't we do it. Base the judgment on what that study shows, and on that you will have no problem with us. We will meet the water quality standards if the area in which we control is what is causing them. We do not believe from an examination of the preliminary data collected by your people this establishes that. This in general is our position on disinfection.

Let's go back to temperature. We have no quarrel--I believe it has been adopted in Missouri, I think we have the same question involved here as we did in Davenport--of the interior streams. Our standard provides for 90 degrees and a 10 degree range. As indicated by Missouri, and we have got the same area, the same type of streams, their experience shows that these extreme temperatures are pretty much the ambient air temperature.

Again a cursory check with any meteorologist will indicate that we have temperatures consistently above 95 degrees up to 100 degrees over this area all during the summer months. Therefore, it seems to us that 90 degrees as a maximum is unrealistic, and for these reasons, our own studies show the same thing in the water temperature, that perhaps 93 is even too low, but we go along.

All right, so much now, as far as I am concerned that covers our position on the areas having to do strictly with water quality criteria. Now we talk about secondary treatment, and this is our difference of opinion and I think it is our really only major area of disagreement.

I saw some statement from somebody,from the Federal pollution people back along before these hearings, about he gave the impression that the States surrounding us adopted something different and were pretty irritated with Iowa because we were fouling up the whole mess. But I have noticed, and I am sure you have, that the people who have given formal statements from other States haven't taken that position in regard to secondary treatment. I recall for your consideration the statement from the State of Illinois, with whom we share a good many miles of stream, the Mississippi River. And they indicated, just as we have indicated, that they didn't have any interest in what the type of treatment was. They were interested, as we were, in maintaining the water quality standards.

I think it is interesting to note the statement given by the gentleman from Missouri yesterday on those streams which are interstate in that they originate in Iowa and are shown on the map and go into Missouri, that again Missouri did not care about what theoretical requirement was made on treatment, but they were interested that the quality of the water be maintained. So the States that have testified in both of these hearings that are our neighbors we find have taken the same position that we have.

Because there are some people at this hearing that weren't at the other. That is the reason I am covering some of these things even though they are in the record, and I guess your people have done the same thing--we have plowed some of the same ground in both hearings. Our position on secondary treatment is this:

R. Buckmaster

No. 1. It is our judgment that the Federal Water Pollution Control Act does not give the Federal Government power to require secondary treatment. In other words, our position there is that their jurisdictional basis is in fact no different than ours, both by the language and by the intent of Congress and by, in my judgment, the historical common law basis for it. Let's touch on that for just a minute because I didn't talk about it at the other hearing.

Any lawyer who has made any research into the history of water pollution control knows that the common law base of riparian rights to water was based on--and I am putting it generally--the right to reasonable use of water so long as he did not adversely affect other riparian owners. And I think this was adopted in most States and in our State as the basic jurisdiction for control of pollution. The reasonable use doctrine could be maintained in private action in a case at common law. In the case where you have adopted pollution control that the State could enforce, where the action is not a private controversy between two individuals, the statutes hold that any user of a stream had a right to reasonable use of that stream so long as he did not adversely affect other users.

Now, this is what the whole basis of water quality standards is based on. You scientifically establish what pollution is. As far as I am concerned, when you have established the standards you have said on the basis of valid research that these values do not adversely affect any of the other uses--recreation, aquatic life, public water supply, industrial, agricultural. I think that about covers the gamut of it. And you are required to do whatever is necessary so that what you introduce into a stream does not exceed these water quality standards which have been determined to protect these uses.

Now, it has never been the philosophy of the law so far as I know in this country--it hasn't been in Iowa as far as I know--where we take the other standard or at least one other test philosophically and say, we are going to require everyone to give any waste the highest possible degree of treatment regardless of whether we can show it is required to protect other users and regardless of the economic cost. It seems to me that the water pollution control people have somewhat adopted this philosophy, that regardless of whether or not we can show an adverse effect on users and irregardless of the economic balance of interests, this is going to be our test. And I think this is where we are in conflict on these two basic philosophies.

There is no question about the Iowa law, in my judgment, as I stated before, I drew the Iowa law. I was on the Governor's committee that studied what Iowa needed in the way of pollution laws and it came out of our study. Our Commission has submitted this matter to the Attorney General of Iowa. He has stated to us in writing that in his judgment our jurisdictional base is on preventing pollution, which means maintaining water quality standards and that we have no power to require any specific type of treatment other than our ability to show that that is required to maintain those standards. This is the legal base for our judgment.

Now, the basis for our judgment on the merits is that neither our studies, which admittedly are sketchy, nor your studies, which on the Mississippi River are no better--in some cases not as good because we have some data in 1950 better on the Missouri River--

but neither established a case for secondary treatment on its merits that that would enhance the water quality, or that it is required to mean the Iowa water quality standards which you accept.

You have put people on the stand here who have stated, and I will summarize them--this is what I think they stated--secondary treatment is better than primary. Well, there wasn't any reason to come all the way from Washington to say that. I think we would have accepted that. It takes out more things than primary treatment does. Tertiary takes out more than secondary. And if you don't have any effluent at all, it takes it all out. I think you can start with that as a premise and we won't quarrel with that.

You have also brought people in to say that certain things can cause taste and odors in drinking water and fish. Well, this didn't come as any great news to us either. We are familiar with that.

What we have talked about is general things as "could" or "might" or "possibly" or "have", but very little has been said about "will" or "do."

As I indicated at Davenport and I indicate today, we will join with you in studies, we will do it any way it can be done. We don't have the people; you have got a lot of them. They tell me you have got 75 in the Kansas City office and I don't know how many in Chicago, and I have been falling all over them at both of these hearings. Actually,if we had spent just about a third as much time surveying the Missouri and Mississippi Rivers as we have running around having conferences and writing letters and doing all the folderol that has kept us really from the pollution jobs for the last two years, we might have some facts on which we could--

Would you pardon me while I take this phone call?

MR. STEIN: Do you want to recess now?

MR. BUCKMASTER: Yes, five minutes and then I will go another ten minutes.

MR. STEIN: Yes. We will have to recess anyway, because we have to have rebuttal and then we will run through it without a recess after that.

MR. BUCKMASTER: All right.

MR. STEIN: May we recess now for ten minutes. When we come back, Mr. Buckmaster will complete his statement, then we will have rebuttal and comments, and we will try to go right through with it.

(RECESS)

MR. STEIN: May we reconvene.

MR. BUCKMASTER: Mr. Stein, I omitted one thing in connection with disinfection on the interior streams. We are at a loss to understand--I indicated this at Davenport and I indicate it here--that the standard which we adopted for year-round treatment of public water supplies and seasonal treatment of recreational areas was accepted, we thought, by the Federal Government, because I had a letter, I referred to today, from Mr. Burd in September of 1968 where he said that this criteria was acceptable. Yet we have spent, both here and at Davenport, a good many manhours talking about something which we thought was all over with.

It seems to me that the Federal people here have overlooked one requirement entirely of the Federal Act. I refer to the portion on what happens after the standards improve and we get to enforcement. The act itself provides what the Secretary has to show in order to enforce either water quality or the implementation of the program. And again I want to quote from the Act itself.

"In any suit brought under the provisions of this subsection the court shall receive in evidence a transscript of the proceedings of the conference and hearing provided for in this subsection, together with the recommendations of the conference and Hearing Board and the recommendations and standards promulgated by the Secretary, and such additional evidence, including that relating to the alleged violation of the standards, as it deems necessary to a complete review of the standards and to a determination of all other issues relating to the alleged violation. The court, giving due consideration to the practicability and to the physical and economic feasibility of complying with such standards, shall have jurisdiction to enter such judgment and orders enforcing such judgment as the public interest and the equities of the case may require."

So ultimately when the Federal Government gets all through, both in meetings and confrontations, and the gold stars are put behind the States that said, "Yes, I will sometime in the future," not one bit of water has been improved at that point. Now comes the question of improving it, and when we come to improve it, the Act sets out what the standard has to be.

It would seem to me, it doesn't make any difference what standards you adopt or what plan of implementation, you are ultimately going to face the fact that it has got to be proven in court, with the Act giving what the criteria are for the court to take into consideration. Where in this hearing, either at Davenport or Council Bluffs, has the Federal Government introduced one iota of evidence about the economic feasibility or the practicability of what it proposes? It seems to me that is a part of your burden of proof. I know very well it is going to be when you attempt to enforce it. It seems to me it is a part of your burden and you haven't introduced any evidence on it.

It is a great thing to sit in an ivory tower and dream up water quality standards without any consideration to other matters that have to be taken into consideration by a responsible public official charged with the responsibility of making orders that people have to reach down in their pockets and pay for.

R. Buckmaster

And if we forget just a minute and concede, which I don't, that we legally could require secondary treatment, and, number two, that we should, right across the board, as a responsible public official let me tell you what I would be facing as a matter of judgment. Our projections show that on the interior streams of the State of Iowa in the next four years expenditures will be required in a magnitude that will require a Federal subsidization, based on the 30 percent, of about $13 million. In other words, the program on the interior streams, which we consider in many areas will present us with a problem in the next four years and a real problem, and I am talking about a problem of meeting our water quality standards, the Federal contribution of 30 percent will be all eaten up for the next four years because we get $3.4 million a year.

If you take the figures, which are $25 million--and my experience with these type of figures in an inflationary era is before you have got the figures put down they have increased--and if we say $25 million today, which is the educated guess is the cost of going to secondary treatment on the Missouri and Mississippi

Rivers, we are probably talking something more in the area of $30 million, this would take all of the Federal contribution for the next 4 years and we would do nothing on the interior streams.

As a public official in the State of Iowa charged with the responsibility of doing the most with the dollars available to us to protect water quality standards, I couldn't justify spending one dime on the basis of the record that you have shown or what we know to be on either the Missouri or the Mississippi River if it meant depleting or cutting out the work that we think is necessary to protect water quality on the interior streams.

Let me point out again that Iowa does not have any State participation in the construction of these facilities. The 70 percent comes from the city or town itself.

I would consider it to be irresponsible action on the part of our Commission to give a priority to secondary treatment on the Mississippi or Missouri over the demonstrated need on the interior streams, and this is entirely independent of the question of either our legal right to do it or the merits of whether or not it should be done.

So I say in conclusion that in our judgment the testimony and evidence that you have adduced here does not, or even approach showing a requirement of general across-the-board secondary treatment. I am also going to concede that very well if such proper evidence were adduced that we may have some areas on both streams that might require it.

So there isn't any question again about our position. I now state that the Iowa Water Pollution Control Commission is ready and willing to engage with your Department on definitive studies of both streams. We are willing to jointly agree on setting up the parameters and agree to be bound and require whatever treatment is required to protect the water quality in both these streams, but we do not intend to require secondary treatment without such scientific basis, and I think I have to say in all fairness that we intend to pursue that position just as far as it is required.

Thank you.

MR. STEIN: Thank you.

Does that conclude the Iowa presentation?

MR. BUCKMASTER: I believe it does. You and I will now get into nits and lice, and scientists will come up and say this and that, and so forth, and we will go through that, but as far as I know, except for answering some of that, we are through.

MR. STEIN: All right. Thank you very much, Mr. Buckmaster.

As you know, the regulations require that we have an opportunity for comment and rebuttal, and we intend to follow the conference requirements and regulations, of course, to the letter.

Is there anyone here now that wishes to make a comment, have rebuttal or make a recommendation as to standards in water quality? I just ask you to do one thing. I think we aired this quite a bit in Davenport and in here. I would hope that this would really be a rebuttal statement and we do not bring in new material at this stage unless you really feel compelled to do so.

Yes. Mr. Blomgren.

REBUTTAL STATEMENT OF
CARL V. BLOMGREN

MR. BLOMGREN: Mr. Chairman, we have listened with interest to the comments presented by the State representatives. We respect their dedication, professional integrity and technical competency. We feel there are several statements in their report that need clarification.

We have presented documentation which shows a greatly expanded scope of water uses when compared to the two shown in Iowa's standards for the Missouri River. These uses must be recognized and protected. Nonrecognition does not reduce the hazard to the user nor can the assumption be made that it makes it an illegal activity.

Recreational use of the Missouri River is a reality. The State of Nebraska recognizes this use. The Corps of Engineers projects more intensified recreational use of the river and is planning considerable expenditures in the development of recreational access sites. This fact was highlighted by the statement of Gen. Cannon of the Corps of Engineers. The Lewis and Clark Trail development will intensify the recreational use by focusing national attention on the Missouri River, emphasizing the historical significance of the river system. And we cannot overlook that today the States of Iowa and Nebraska have 66 developed access sites for recreation.

Iowa recognizes water supply use only at the water intake for Council Bluffs. Yet Omaha, Nebraska on the opposite bank from Council Bluffs uses the river as a water supply source, and St. Joseph, Missouri, 160 miles downstream also depends on the river for water supply. Full consideration must be given to these other water users through full protection of the river quality.

Over 85 percent of the coliform bacteria in the river during dry weather flow studies were contributed by municipal waste discharges.

The material presented by Mr. Geldreich establishes the high degree of control of the bacterial densities that can be obtained from properly operated secondary treatment with disinfection. Dr. Walton emphasized the importance of this control in his description of the multiple barrier concept for the protection of the water users. The waste treatment plant is the first line of defense between the wastes of a community or industry and the downstream water users. This concept is further supported by the statements submitted by the Missouri River Public Water Supplies Association. The protection of the health and well being of their consumers is dependent on the production of high quality drinking water. With only men and machines standing between the river and the consumer, the river must be of the highest possible quality.

Disinfection is required on a year-round basis. During the warmer seasons, disinfection is necessary to reduce the hazard of contact with disease-producing agents by recreational and other users and to provide a more acceptable source for domestic supplies. During the cold weather periods, disinfection is equally important. Mr. Geldreich discussed the bacterial persistence at lower temperatures fully supporting the need to provide all possible protection for the downstream user.

Wet weather flows do not negate the

effect of disinfection of waste effluents. Elimination of potential sources of pathogenic organisms before they reach the river is common sense. The control of bypassing because of storm flows or mechanical failure is an objective of all water pollution control agencies.

The State of Nebraska has adopted criteria for coliform organisms. These criteria were set to protect the river for domestic water supply and for partial body contact, fishery propagation, agricultural, industrial uses and others. Basically, the coliform group shall not exceed a geometric mean of 10,000 total or 2,000 fecal coliform bacteria per 100 ml, based on at least 5 samples per 30-day period. These stream criteria can be achieved only through disinfection of waste effluents. I believe this question arose yesterday, Mr. Chairman. You will recall that specific treatment requirements calling for disinfection on the Missouri River were not spelled out in the Nebraska standards for the Missouri. However, the stream quality criteria dictate that disinfection is essential.

Agriculture runoff effects on the quality of the Missouri River are now outside the scope of controllable standards. The farm animal population with an estimated 65 million population equivalent of waste products presents a real threat, at least in part if not in total, to the water quality of the basin. Mr. Geldreich's statement concerning the pathogenic organisms present in the excreta of animals emphasizes the disease potential. There are about 46,000 feedlots within the State of Iowa, but only the larger control facilities are State regulated. If the larger ones can be controlled, the smaller ones can too.

Yesterday at the close of the FWPCA summary statement, a question arose about the Department of Interior's interpretation of the requirements for secondary treatment on the interior interstate streams of Iowa, and at this time I would like to again bring Bob Burd forward for a clarification of that point, Mr. Chairman.

REBUTTAL STATEMENT OF
ROBERT BURD

MR. BURD: Mr. Chairman.

I would like to make a brief statement to clarify a point raised yesterday concerning the Federal approval of water quality standards for Iowa's interior interstate streams.

It was the Secretary of the Interior's understanding that the standards he approved as Federal standards, standards applicable to the interior streams of Iowa, included a general requirement of secondary treatment for municipal and industrial wastes discharged to these streams. Why did he reach this conclusion? The Iowa standards include the following statements:

"All municipalities on interior streams will generally need secondary treatment and some already have two stage filtration or other tertiary treatment furnishing up to 96 percent BOD removal.

"All industries will be required to provide the same degree of treatment or control that is required of municipalities on the same reach of stream. This degree of treatment will generally be the equivalent of secondary treatment" as a quote from the Iowa standards.

Furthermore, the Iowa implementation plan, what we consider to be the action part of the standards, supports these two statements. It shows that secondary waste treatment has been installed or will be installed by all but a very few dischargers. I would like to quote Iowa's statement prepared for this conference:

"Secondary treatment will be needed, and therefore has or will be required for all but four or five of the 490 municipal sewage treatment plants located on interior streams."

We were impressed with this record; 99.2 percent of the municipal facilities discharging to interior streams to provide a minimum of secondary treatment.

On the basis of this admirable record and the general policy statements on secondary waste treatment, the Secretary approved the standards of the interior streams, with exceptions for temperature and the approach to disinfection.

MR. STEIN: Thank you.

MR. BUCKMASTER: Could I answer one statement he made before we get on this other subject?

MR. STEIN: Yes, go right ahead, sir.

MR. BUCKMASTER: I don't think I need to come up there. I think you can hear me.

I am disturbed by the statement about agricultural and animal wastes that you mentioned. Now, we all recognize that a great deal of the coliform bacteria come from animal wastes. But it seems to me you indicate a real lack of knowledge about the agricultural industry in the State.

You keep talking about feedlots and you give the assumption to somebody that doesn't know about it that a great part or all of animals in the State are in feedlots. Well, this is absolutely not true. The vast majority of the swine and cattle in the State of Iowa are on open pasture and in fields, are not confined, and the coliform come not from feedlot sources but from animals all over our terrain.

And you make the statement if we could control large feedlots we can control small ones. Explain to me how over the whole State of Iowa, which is all agriculture and which has cattle and swine on pretty nearly every acre of it, the Iowa Water Pollution Control Commission is going to control runoff from those fields.

MR. STEIN: Do you want to address yourself to that or does someone else want to answer that or do you want to continue?

MR. BLOMGREN: I want to continue.

MR. STEIN: All right.

MR. BLOMGREN: Now, Dr. Morris, although we have requested that the phenol question on criteria will not be discussed because we felt we had some agreement, there was a question from Dr. Morris and I would like to call on our technical consultant, Dr. Aaron Rosen, at this time to speak to some of the points that Dr. Morris brought up.

REBUTTAL STATEMENT OF
DR. AARON ROSEN

DR. ROSEN: I understand that yesterday it was stated that the question of a standard on phenols is not an issue and, therefore, I am not going to say anything as to what modification of the original proposed standard has been arrived at, but rather I am under the understanding that it includes a terminology relating to phenols of municipal and industrial origin as opposed to the natural ones that Dr. Morris spoke about. Let me point out that Dr. Morris and I are on a number of committees in this field of organic material in water, including especially those relating to taste and odors, and we have no conflict at all on a scientific basis.

We can distinguish between those materials of natural origin of the type that he mentioned, and I agree that what he said was a proper statement of the source of many such materials and their occurrence in streams. We can distinguish between these which, as he said, have, at least so far, not been reported to be causes of taste and odor from those which he agrees are causes of taste and odor, that is those materials of waste origin. Analytical means are available and they are sensitive enough for the purpose of determining and identifying quantities as low as one microgram per liter, or in the engineers' terms, which are the ones most of us use, one part per billion.

There are several approaches to these, to doing this. I don't want to enumerate all the different analytical methods. I just want to mention that there was a recent publication specifically directed to this and specifically stating that sensitivities for the identification and determination of phenols, by this we mean the kind of phenols that do **chlorinate and do produce** a problem, that these sensitivities range as low as one-tenth part per billion. So that from the viewpoint of the chemist, a viewpoint which says we apply these criteria to the kind of phenols that produce the specific adverse effect, that such a criteria can be implemented in terms of the analytical capability.

MR. BLOMGREN: Mr. Chairman, in response

to Dr. Morris's question about monitoring, I will ask that this be placed in the record in response to Dr. Morris and offers cooperation in setting up a joint monitoring system and program.

MR. STEIN: That will be done.

(Which said document is as follows:)

MONITORING

Although monitoring is not an issue at this hearing, we believe the record should show FWPCA's position on this matter. We feel that it is unfortunate that Section IV-D of the FWPCA report, dealing with monitoring, was interpreted by Dr. Morris as a criticism of Iowa's monitoring program.

The monitoring section of the report was intended to support current and future monitoring efforts of the Iowa Water Pollution Control Commission. The recommended increases in sampling frequencies for chemical, physical and bacteriological parameters at stations located on the ten streams cited in the report represent our current thinking on optimum surveillance needs on streams receiving significant amounts of wastes.

C. V. Blomgren

The FWPCA Missouri Basin Region is actively engaged in coordinating the development of a cooperative Federal-State-local monitoring plan. One of the principal benefits of such a cooperative approach would be the elimination of duplication of monitoring efforts and would permit greater numbers of sampling stations to be operated as well as increased sampling frequency. We have discussed monitoring with all of the Missouri Basin States except Iowa. Hopefully, we can meet with the technical staff of the Iowa Water Pollution Control Commission in the near future to discuss monitoring needs and determine the technical and financial resources required to carry out an effective monitoring program.

- - -

MR. BLOMGREN: Relative to Kansas water quality standards, which was brought up yesterday and part of this morning by reference, we do have a commitment from the State of Kansas, and I will quote from their treatment requirements, a commitment for secondary treatment. I can't inform you of the status of the approval or disapproval of those standards, but based on a letter from the Governor of January 16, 1969, we have a commitment for secondary treatment from the State of Kansas.

Under treatment requirements in their standards, the objective of treatment or control will be to reduce the organic levels, oil, grease, solids, alkali, acids, toxic materials, color and turbidity, taste and odor products, and other deleterious materials to the lowest practicable level.

Mr. Schliekelman's reference to the cost of clean waters, a sheet taken from our publication, was, we believe, adequately covered by Mr. Frank Hall's statement which went into the Davenport record.

There were some questions that arose yesterday with reference to bacteriological pollution, differentiation, and Mr. Buckmaster brought them up again this morning. Ed Geldreich, our last technical consultant, would like to make just a few brief remarks on that and that will be our closing.

REBUTTAL STATEMENT OF

E. GELDREICH

MR. GELDREICH: Mr. Chairman, as I did in

Davenport, I would like for the record to comment on the Iowa statement, on page 15 under Public water supply and recreation, the suggested numerical bacteriological limits. They state that their bacteriological limits are compatible with the National Technical Advisory Committee's recommendation, and the values, as I said at that time, now are compatible, but there was one phrase in there that I would like to comment on: "when such bacteria can be demonstrated to be attributable to pollution by sewage."

There is nowhere in the recommendations of the water quality criteria book that was put out by the committee that so specifies or selectively narrows in on the fecal coliform population that we are concerned with. Just as an illustration, I would like to quote that particular recommendation as it is on page 12 of the water quality criteria book:

"Fecal coliforms should be used as **the** indicator organism for evaluating the microbiological suitability of recreational waters."

There is no mention here in any of the phraseology that it is to be specific for pollution, fecal pollution, from sewage only, and I would like to make that comment.

And as we have said yesterday morning and this morning again it was reiterated, we are concerned with all fecal pollution. There is no need to go into the differentiation of the types of fecal pollution, because we are concerned with a hazard from all. The fecal coliform test is all we need to do. You don't need all the supplemental tools that we have available for this particular problem.

Thank you.

MR. STEIN: Thank you.

Are there any other comments?

MR. BLOMGREN: Yes, I would like to speak to Mr. Buckmaster's question concerning feedlots and particularly his expression of some doubt about the size of the number of feedlots we had in our statement.

This is certainly a problem and I won't pretend to set up a criteria for the control of all feedlots regardless of size at this time, but it will take a lot of cooperative effort, undoubtedly some research and demonstration grants could be used to achieve this purpose. Certainly we stand ready to assist the State of Iowa in this.

MR. STEIN: Are there any other comments or statements?

Mr. Schliekelman.

REBUTTAL STATEMENT OF
R. J. SCHLIEKELMAN

MR. SCHLIEKELMAN: I might add, sir, Mr. Geldreich's comment on this public water supply and recreational use limits that was set up here, this actually should follow the portion of the criteria which we have dealing with bacteria, which is as follows:

"Water shall be considered to be of unsatisfactory bacteriological quality as a source when:

"A sanitary survey indicates the presence or probability of the presence of sewage or other objectional bacteria-bearing wastes or

"A bacteriological survey using coliform or other appropriate indices indicates bacteriological concentrations significantly higher than those normally found or suspected in these waters when free from pollution by sewage."

Actually this phrase that we have at the end of this addition does not particularly apply or is not intended to actually demonstrate in our testing sewage bacteria. We are talking about sources where these bacteria might be coming from. I think you have got to read everything together.

MR. STEIN: Thank you.

Are there any other comments?

Mr. Buckmaster.

MR. BUCKMASTER: Since there has been some controversy about what Kansas has done and since a representative of Kansas is here, I would like to have him state what their position is at this time.

MR. STEIN: We will be delighted.

MR. GRAY: Would you like to hear from me with a few comments?

MR. STEIN: Yes, sure.

STATEMENT BY MELVILLE W. GRAY
ASSISTANT DIRECTOR OF ENVIRONMENTAL HEALTH SERVICES, KANSAS STATE DEPARTMENT OF HEALTH, TOPEKA, KANSAS

MR. GRAY: I am Melville W. Gray, Assistant Director of Environmental Health Services, Kansas State Department of Health.

As a result of passage of the Water Quality Act of 1965, Kansas submitted proposed water quality standards to the Department of the Interior. At that time Kansas had 34 primary treatment plants throughout the entire State. The remainder were secondary treatment plants. Since that time, through routine programming, these have been reduced to 28 primary treatment plants.

The Department of the Interior requested the State of Kansas to require secondary treatment from all facilities and later amended this to include significant sources and listed 16 municipalities which should be providing the secondary treatment. The Governor of

Kansas submitted a letter to the Secretary of the Interior indicating that with considerable reluctance and against the advice of his technical staff he would agree to a date of 1985 as a goal for the provision of secondary treatment from these 16 plants.

The Kansas State Board of Health, which is by law the official water quality regulatory agency, accepted the Governor's letter and attached it as an appendage to the plan of implementation with no further action.

MR. STEIN: Are there any further comments or questions?

Mr. Rademacher.

REBUTTAL STATEMENT OF
JOHN M. RADEMACHER

MR. RADEMACHER: I am John M. Rademacher, Regional Director for the Missouri Basin Region, FWPCA.

I believe that there is one significant point that has to be made in response to Mr. Gray's comment that the date of 1985 was a goal. I believe as submitted by the Governor and also accepted by the Department of Health or the Board of Health in Kansas on February 7th, and I quote the submission--now, I don't know what the status of approval or disapproval is, but our understanding as we read this is a commitment to secondary treatment:

"This policy shall be applicable to all interstate waters in the State with the provision that an abatement timetable will be submitted to the Department of the Interior by or before December 31, 1969, for the significant municipal and industrial waste sources and further that all facilities shall be in operation prior to completion of equivalent Missouri River downstream facilities but in no case later than 1985."

And, of course, the comment that Mr. Blomgren made earlier about "The objective of treatment or control will be to reduce the organic levels, oil, grease, solids, alkali, acids, toxic materials, color and turbidity, taste and odor products, and other deleterious materials to the lowest practicable level."

In our view, this is a commitment to

secondary treatment and a time schedule to it.

MR. STEIN: Are there any further comments or questions?

Maybe we had better cover this. There is one advantage to this comment period. What we eventually do is get Gray and Rademacher up to the stand and I am glad to see you both.

Are there any others? Mr. Carlson, did you have something?

STATEMENT BY FRANK L. CARLSON
ENGINEER, GENESEE COUNTY, MICHIGAN
DRAIN COMMISSION POLLUTION CONTROL
FLINT, MICHIGAN

MR. CARLSON: I am Carlson and I am from Genesee County in Michigan.

I am one of the indians that has to do the work of producing these pollution control sewage disposal **plants, etc.** like that. We are the Genesee County Drainage Commission. We put in the sewer pipes, we build the disposal plants, and we think we could make some recommendations to you chiefs on how maybe this could be done a little bit better and we could suggest that you integrate a little bit with your air pollution and land pollution and water pollution. If this was integrated in one big program, perhaps it would work for the betterment of the whole solution, the whole problem.

I would like to make a couple of drawings on your board here for just a suggestion on how to control pollution, water, air, and so forth.

MR. STEIN: You know, what we are interested in, really, is the record. Now, I have no objection to you drawing it on the board, but we have no way of introducing that in the record. O. K.?

MR. CARLSON: I don't want to take too much of your time. I know this is probably not relative to your particular problem here, but I was just passing through and I felt obliged to make a comment on it. Add anything that you might--

MR. STEIN: Did you want this material in the record?

MR. CARLSON: No, I have nothing to put

in the record.

MR. STEIN: O. K. Thank you.

Are there any other comments or statements, any at all?

(No response.)

I think we are about to the point where we are going to close.

Let me make one observation from sitting up here for a couple of days. You know, when you look at things carefully you see things that possibly you don't expect in a situation.

For example, when I got into this hotel I thought that I was in a traditional hotel public room that is repeated over and over again through the United States. For example, if you look at the decorations on the wall, they all seem to be derived architecturally from the late Roman period. I think the one there over the door, they seem to have replaced the medallion in the middle with the seal of Iowa. But if you look very, very carefully at this and look at that place where they have the seal of Iowa, you see those two figures, and what do we have? The legs on the two figures and the feet extend outside the frame and outside the panel, and this is something that obviously you would never get in the pure Roman form.

So I think if you look hard enough, you may find things that ordinarily are not apparent and maybe we can do that here too.

I would like to thank both the representatives from the Federal Water Pollution Control Administration in Iowa and all the other people who have participated in Davenport and in Council Bluffs in these conferences.

I think the conferences have been characterized by a clear statement of the problem. Some of you who have sat through both may not think it is so clear, but I think everybody has to use **his** own mode of expression in getting **his** point of view across. Obviously, a representative of a women's organization or citizens' group is going to put its view forward in one way, a State or Federal administrative official is going to say it in another way, the biologists and the chemists and the microbiologists all have their way of putting what they think their views are on the record. What this has done is provide a forum where we have been able to get these views.

At least I have a clear understanding of where we are going, not necessarily where we are going but what everyone wants to say. There may be certain points on which the technical people in a particular specialty may not have resolved every last little issue. However, I am not overstating this when I say Iowa and we probably can arrive at a judgment without resolving all these minutia. We have enough of the views from all the parties concerned and they are really set forward on the record.

I know both we and Iowa have a formidable task ahead. I would like to give a personal opinion on one. It is abundantly clear that the officials in Iowa and the officials in the Federal Government both want to get an equitable and an expeditious program going forward to assure that we will control and prevent water pollution and have clean waters in the Missouri and Mississippi Basin. I don't think there is any question about that.

There is another point that we

should recognize before this gets out of perspective. Setting the standards, like any other one of the aspects of the program we have, is just a tool toward achieving these objectives. One thing about the setting of standards, and I think this is clear, no matter how much you refine them or how much you set the standards, by Iowa, by the Federal Government, by any other instrumentality of government or jurisdiction, I don't think just the setting of standards is going to clean up water one bit.

This is a method whereby we get to the real problem of cleaning up water. If we are going to clean up water, what is necessary, and I say where it is appropriate, is for the wastewater sources to be gathered together in a place where they can be treated or diverted and the water be kept clean. What I would hope is that the governmental agencies do not spend all their time in this preliminary area when we have the hard job of going out and controlling pollution. We don't want to get the methodology to exceed the aims of the program. And I think it behooves us all not to get caught up in a proceeding, however entertaining you might think this is, without keeping the idea that the real objective that we have is the preservation of the water quality in the Mississippi and Missouri Basin in this area. This is the job on which we have to move forward.

I would hope that we would be able to not only come to a full agreement with Iowa, but with all the States in the basin so that the Federal Government and the various States can move on in concert to get the job done. In addition to that, as we well realize, unless we have the real cooperation of the municipalities, counties and the cities, the job is going to be that much harder. Let us not get on a sidetrack or a siding, let's not, I hope, get into a cul-de-sac where we can't find our way out, but let's get on with the job of providing the cleanest possible water for the maximum number of water uses in an equitable way so that the municipalities, the industries, the States, and the Federal Government can all live with that.

With that, we will stand adjourned and I would hope that a resolution of this problem which is satisfactory to all parties can be forthcoming.

Thank you all for your participation.

(ADJOURNMENT)

- - - - -

UNITED STATES
DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
MISSOURI BASIN REGION
911 Walnut Street, Room 702
Kansas City, Missouri 64106

IN REPLY REFER TO: April 28, 1969

TO: Commissioner, Federal Water Pollution Control Administration
Attn: Assistant Commissioner, Office of Enforcement

FROM: Regional Director, FWPCA

SUBJECT: Water Quality Standards Conference, State of Iowa

Attached are additional statements which we desire to have included in the official record of the Water Quality Standards Conference, State of Iowa, Council Bluffs session.

Copies are being provided to the conference recorder and the Iowa State Water Pollution Control Commission.

for JOHN M. RADEMACHER

Attachment
Iowa Beef Packers' Report
Bureau of Outdoor Recreation's Statement
Nebraska Water Quality Criteria

CLEAN

UNITED STATES
DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
MISSOURI BASIN REGION
911 Walnut Street, Room 702
Kansas City, Missouri 64106

IN REPLY REFER TO: April 28, 1969

TO: Record

FROM: Regional Director, FWPCA

SUBJECT: Nebraska Water Quality Criteria

The following is a verbatim extract from the "Water Quality Standards Applicable to Nebraska Waters," adopted by Water Pollution Control Council, State Department of Health, Lincoln, Nebraska, and dated January 1969.

Waste water shall not degrade the receiving waters below the following criteria. These criteria . . . .

5. Temperature

For Class "A" Use - (Domestic Water Supply)
And Class "B" Use - (Full Body Contact Sports)

The temperature of the receiving water shall not be increased by a total of more than 5° F from May through October and not more than a total of 10° F from November through April. Maximum rate of change limited to 2° F per hour.

For Class "C" Use - (Agricultural uses including irrigation and livestock watering. Partial body contact sports. Growth and propagation of fish, waterfowl, fur bearers and other aquatic and semi-aquatic life and wildlife. Industrial.)

Trout Streams

Allowable change 5° F - Maximum limit 65° F.

Warm Water Streams

Allowable change 5° F May through October; 10° F November through April. Maximum limit 90° F - maximum rate of change - limited to 2° per hour. For Missouri River from Gavins Point Dam to Sioux City, Iowa - maximum temperature 85° F, allowable change 4° F.

The classification of waters of the State is covered in detail in Appendix XI of the Nebraska Standards.

JOHN M. RADEMACHER

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6
UNITED STATES GOVERNMENT

Memorandum

TO : C. V. Blomgren CVB
Director, Technical Support

DATE: April 24, 1969

FROM : Sanitary Engineer

SUBJECT: Report on Iowa Beef Packers - Sampling and Plant Inspection Trip, March 26-28, 1969

During the three day trip, the following persons were contacted at the Iowa Beef Packers' Dakota City, Nebraska, installation:

Henry Blumm, Nebraska Department of Health
James Chittenden, Technical Director, Iowa Beef Packers
David Osborn, Chemist, Iowa Beef Packers

Pertinent details of plant facilities and operations are listed below:

1. Kill period - 16 hours - 2-8 hour shifts
2. Cleanup - 8 hours
3. Kill - 2000 to 2500 head
4. Total employees - 1100
5. Average water usage - 1650 gpm from a well system through pressure sand filters
6. Waste treatment

Domestic Treatment - Pacific Industrial Engineering

This plant at the time of inspection has suspended solids of 10 mg/l in the contact tank. There was no recirculation, no skimming on the final tanks and no indication that the plant was receiving any maintenance at all.

Process Wastes

All process wastes go through an air flotation tank for grease and grit removal. At the time of the visit, no air was being supplied and no suction on the grease removal trough. A four-inch layer of grease covered the flotation tank.

Stockyard Wastes

Wastes from the stockyard area are washed into two settling basins designed to remove settleable solids with a 30 minute minimum detention. At the time of the visit, both tanks were full of wastes and short-circuiting directly to the outlet.

5010-108

Buy U.S. Savings Bonds Regularly on the Payroll Savings Plan

There are no BOD data available for the combined wastes from this plant. A year ago, the Nebraska Department of Health ran one set of samples and lost all BOD's because of insufficient dilution. At that time, the effluent's suspended solids ranged from 800 mg/l during cleanup to 1500 mg/l during kill periods and grease concentrations were approximately 550 mg/l.

At the Dakota City plant, all wastes are combined into one main sewer. Analytical values for comparable wastes at the company's West Point Nebraska plant are:

Operation Period	Kill	Cleanup #1	Cleanup #2
Grease ppm	364	370	161
Susp. Solids ppm	404	506	-
Total Solids %	0.261	0.298	
Volume of Water (gal)	476,200	132,000	95,000
BOD_5	1175	1375	900

Total kill for the West Point plant is 1050 to 1100 head.

At the Dakota City plant, 11 samples were collected at two-hour intervals during the operational period on March 27, 1969, and pictures were taken of the outfall and plant waste treatment devices.

Plant Operation

During the survey period, the plant was operating on a 13 hour kill. On March 27 and 28, a perfect kill (no stoppages during kill period) was obtained and with a chain speed of 163 animals per hour, this amounts to 2,119 head per day. Water use during the two days varied from 2.5 to 2.75 million gallons per day based on pumping records on the company-owned water supply. Operations during the sampling period were as follows:

Start Kill	05:25
15 Minute Break & Cleanup	08:30 to 08:45
30 Minute Lunch & Cleanup	10:30 to 11:00
15 Minute Shift Change & Cleanup	14:15 to 14:30
15 Minute Break & Cleanup	17:30 to 17:45
30 Minute Shift Change & Cleanup	19:30 to 20:00
Peak Cleanup Flow, Approximately	22:30

Sampling Operations

During the period from 5:00 a.m., March 27 to 1:00 a.m., March 28, samples were collected from the combined waste line from the Iowa Beef Packers plant. These samples were air lifted to the interim laboratory of FWPCA in Kansas City and analyzed for BOD and solids according to the standard methods. Data for the samples listed as 3:00 a.m., March 28, were estimated to provide a complete 24-hour sequence.

Date	Time	Estimated Flow (mg)1/	Temp. °C	BOD5 mg/l	Calculated lbs.of BOD5	TSS mg/l	SS mg/l	Grease ppm
3/27	0500	0.154	25	386	495	165	2.5	188
3/27	0700	0.228	26.5	812	1544	530	3.0	
3/27	0900	0.247	25.5	1500	3089	1180	8.0	
3/27	1100	0.247	26.0	1285	2647	1400	7.0	297
3/27	1300	0.228	26.5	1489	2831	1300	4.0	
3/27	1500	0.214	27.0	1895	3382	1760	7.5	
3/27	1700	0.247	26.0	1676	3452	1160	5.0	305
3/27	1900	0.228	26.5	1616	3072	860	7.0	
3/27	2100	0.214	25.5	2481	4428	1080	6.0	
3/27	2300	0.228	26.0	1399	2660	740	8.5	
3/28	0100	0.294	25.5	1636	4071	1240	3.5	
3/28	0300	0.214		950	1693			
Total		2.75 mgd			33363			
Avg.			26.0	1427		1038		

1/ Flows were estimated for each two-hour period from invert elevations on discharge line at the sampling location. Total flow of 2.75 mgd agrees with the figure furnished by IBP officials. The 0300 sample is extrapolated data.

Settleable solids were also run in the field using an Imhoff Cone. Results of these tests are:

0800	3/27/69	Combined Wastes	14 ml
1000	3/27/69	Domestic Waste Effluent	10 ml
1200	3/27/69	Combined Wastes	9 ml

At several times during the day's sampling, excessive floating solids (meat scraps and grease) were observed in the samples collected at the combined waste sampling point.

Remarks

We can assume that a representative raw domestic sewage would contain approximately 0.167 pounds 5-day BOD/P.E./day. On this basis, the IBP effluent represents an organic load as listed below:

1. Equivalent to 200,000 population community raw discharge.
2. Assuming 35 percent BOD removal equivalent to 300,000 population primary discharge.

3. Assuming 85 percent BOD removal equivalent to 1,250,000 population secondary discharge.

Bill Keffer
WILLIAM J. KEFFER

MARCH 3, 1849

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF OUTDOOR RECREATION
MID-CONTINENT REGION
BUILDING 41. DENVER FEDERAL CENTER
DENVER. COLORADO 80225

IN REPLY REFER TO:

D 6431

APR 11 1969

Memorandum

To: Regional Director, Federal Water Pollution Control Administration, Kansas City, Missouri

From: Regional Director, Mid-Continent Region

Subject: Bureau of Outdoor Recreation Statement - Water Quality Setting Conference - Iowa Interstate Waters of Missouri River Basin Council Bluffs, Iowa - April 15, 1969

Enclosed are five copies of the subject statement. Since we do not propose to have a representative at the Council Bluffs Conference it is requested that the Bureau of Outdoor Recreation statement be read and entered into the record of the hearing. We would appreciate receiving a copy of the hearing minutes or summary when complete.

for R. H. Sharp
Maurice D. Arnold

Enclosures

Water Quality Standards Conference
Iowa Interstate Waters of the Missouri River Basin
Council Bluffs, Iowa
April 15, 1969

Statement

U.S. Department of the Interior
Bureau of Outdoor Recreation
Mid-Continent Region
Denver, Colorado

During the last decade, the people of this country have become increasingly conscious of the current and potential values of outdoor recreation, and much of this interest has been centered around the use and enjoyment of our water resources. All indications point toward a future need to provide not only more but a wider variety of outdoor recreation opportunities.

Recent trends indicate a rapidly increasing interest and participation in water-based recreation activities, especially in swimming, boating, water-skiing, and skin diving. There is also a growing interest in nature photography and study, often involving the aquatic environment.

We estimate that the number of occasions in which people will engage in water-oriented recreation activities will increase about 160 percent during the next 40 years. In the Missouri River Basin, a portion of which is the subject of this conference, our studies indicate that there is a large demand for outdoor recreation opportunities which remains unsatisfied. Obviously, any factor which tends to endanger or reduce the amount or number of clean water areas, and aesthetically attractive streams, lakes, or shore areas suitable for recreation purposes should be of great concern to everyone involved in managing our natural resources for public benefit.

Water serves three basic needs of recreationists: consumptive, i.e. drinking and cooking supplies; surface and volume for water contact activities, fishing, and boating; and for aesthetic enjoyment. Water areas also are vital to the preservation of fish and wildlife, unique biotic communities and, in combination with adjacent lands, the highly valued scenic natural character of certain areas.

The Bureau of Outdoor Recreation is interested in seeing quality recreational opportunities provided. Polluted water is not compatible with this goal. It is not only undesirable for boating, water-skiing, and swimming, but is unattractive for camping, picnicking and may be a health hazard in connection with these and other water contact uses. The polluting of recreational waters results in decreased use and can render areas totally unsuitable for such use. Although progress in the abatement of pollution is considerable, large amounts of pollutants still are being discharged into our water courses.

We are vitally concerned about the maintenance of good water quality in all streams in the State of Iowa, and we have specific concerns about the water quality of the Missouri River Basin and especially in the Floyd, Nishnabotna, Big Sioux and Little Sioux River.

Surveys have revealed that the Missouri River Basin, including a portion of Iowa, is endowed with a wide variety of recreation, scenic, historic, and natural values. Many of these values depend upon the quality of water available. Interest has been shown for development of state parks and recreation areas including a 1,000 surface acre lake near Sioux City, Iowa. Corps of Engineers' projects involving approximately 18 reservoirs in the Boyer, Big Sioux, Nishnabotna and Little Sioux River Basins are presently under study.

Also being considered is the development of Oxbow Lake projects which will provide approximately 2,400 acres of water valuable for recreation and fish and wildlife uses.

It is clear then that national goals as well as local and State interests in outdoor recreation and environmental quality are effected by the availability of clean water.

In regard to the water quality standards in the State of Iowa, the Bureau of Outdoor Recreation recommends that all interstate waters be designated for outdoor recreation use and be maintained at a quality which will support primary or secondary contact recreation use. Specific water quality for these uses are set forth in the April 1, 1968 Water Quality Criteria, Report of the National Technical Advisory Committee to the Secretary of the Interior.

March 3, 1849

UNITED STATES
DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
MISSOURI BASIN REGION
911 Walnut Street, Room 702
Kansas City, Missouri 64106

IN REPLY REFER TO:

April 30, 1969

TO: Commissioner, Federal Water Pollution Control Administration
Attn: Assistant Commissioner, Office of Enforcement

FROM: Regional Director, FWPCA

SUBJECT: Water Quality Standards Conference, State of Iowa

Attached is an additional statement which we desire to have included in the official record of the Water Quality Standards Conference, State of Iowa, Council Bluffs session.

Copies are being provided to the conference recorder and the Iowa State Water Pollution Control Commission.

JOHN M. RADEMACHER

Attachment

CONTINUATION OF MISSOURI BASIN REGION, FWPCA, REBUTTAL STATEMENT

In deference to the statement (Iowa Water Pollution Control Commission's statement, 1969, page 11, paragraph 3, line 4), that the first 74 miles downstream from Sioux City discharges reflect water quality conditions "superior" to those upstream from Sioux City is not entirely correct. The basis for this statement results from the comparison of types of bottom assoicated organisms and their relative numbers. It must be remembered that the majority of collections were of a qualitative nature and can, therefore, be misleading in terms of relative numbers and the presence or absence of a particular species of benthos. In many instances, a qualitative collection may miss certain individuals because of habitat restrictions, etc. When this happens, the total evaluation of an area may be biased in terms of the numbers of different kinds found. Benthic sampling of large streams or rivers is difficult due, in part, to the variety of natural substrates encountered. It is impossible to obtain representative fauna, even within a limited area, because of shifting substrates, variable or high streamflows and a host of other physical factors.

A number of artificial substrate samplers have been built by investigators to facilitate or improve benthic sampling, Scott1/, Hester and Dendy2/. During the Missouri River Survey (October 1968), the biology unit utilized artificial substrate samplers described by Mason, et. al.3/, to monitor water quality in the Sioux City area. The samplers were installed on the Iowa side of the river and remained submerged for a period of 40 days (10/11-11/19/68).

Results and Discussion

Station 737, approximately 3 miles upstream from the Big Sioux River confluence, reflected a diverse and clean water assemblage of benthos. The total number of organisms numbered 396. Of this number, 97 percent was pollution sensitive, 3 percent intermediate forms, and no pollution tolerant forms recorded.

Station 730, approximately 1 mile downstream from the Floyd River confluence exhibited a considerable reduction in total numbers and pollution sensitive forms, while there was an increase in intermediate and pollution tolerant forms. Of the 131 organisms collected, only 59 percent of the benthos was pollution sensitive, while 40 percent was intermediate forms and 1 percent was pollution tolerant.

Station 723, approximately 6 miles downstream from the Sioux City STP reflected severe degradation of water quality. From the 133 organisms collected, 45 percent was pollution tolerant, 29 percent intermediate forms and 26 percent was of the pollution sensitive type.

The artificial substrate sampling in the Sioux City area clearly defines an abrupt change in water quality affecting the benthic community. It is interesting to note that the stonefly which Iowa based much of their rebuttal on was absent from all of the samples, and the diversity of mayflies in this case was restricted to one genera. However, the number of mayflies encountered at each station is significant. Iowa states that "mayflies are also pollution intolerant organisms which require high water quality." The number of mayflies was reduced from 65 (Station 737) to only 1 individual (Station 723). Caddisflies not mentioned by Iowa, but which are in the pollution sensitive group, were reduced in numbers from 320 (Station 737) to 33 individuals (Station 723).

Also of considerable importance is the occurrence of tubificidae in large numbers (60) at Station 723. The tubificidae commonly termed "sludgeworms" prefer and thrive in a highly organic environment. The sampler at Station 723 was suspended off the bottom but nevertheless collected large amounts of drift organic material creating a favorable environment for the sludgeworms.

The results from the artificial substrate program reflect water quality degradation of a high degree downstream from the Sioux City area. This is contradictory to Iowa's statement (page 11, paragraph 4, line 15) that the biological quality was not "deteriorated" by the Sioux City discharge.

REFERENCES

1. Scott, D.C., 1958. Biological Balance in Streams. Sewage and Industrial Wastes, 30(9):1169-1173.
2. Hester, F.E. and J.S. Dendy, 1962. A Multiple-Plate Sampler for Aquatic Macroinvertebrates, Trans. Amer. Fish. Soc., 91(4):420-421.
3. Mason, Wm.T., Jr., J.B. Anderson, and George E. Morrison, 1967. A Limestone-Filled Artificial Substrate Sampler for the Collection of Macroinvertebrates from Large Streams. Prog. Fish Cult.

STATION 737

POLLUTION SENSITIVE		INTERMEDIATE		POLLUTION TOLERANT	
Hydropsyche	149	Hyella	2		
Cheumatopsyche	75	Asellus	5		
Neureclipis	96	Erioptera	1		
Stenonema	65	Polypedilum	1		
	385	Conchapelopia	2		
			11		0

STATION 730

POLLUTION SENSITIVE		INTERMEDIATE		POLLUTION TOLERANT	
Hydropsyche	5	Hyella	46	Tubificidae	1
Cheumatopsyche	4	Orthocladius	4		
Neureclipis	67	Cricotopus	1		
Stenonema	2	Polypedilum	1		1
	78		52		

STATION 723

POLLUTION SENSITIVE		INTERMEDIATE		POLLUTION TOLERANT	
Hydropsyche	6	Cricotopus	2	Tubificidae	60
Cheumatopsyche	17	Polypedilum	1		
Neureclipis	10	Orthocladius	1		
Stenonema	1	Glyptotendipes	1		
	34	Conchapelopia	1		
		Asellus	33		
			39		60

Iowa
State Department of Health

LUCAS STATE OFFICE BUILDING
DES MOINES, IOWA 50319

JAMES F. SPEERS, M.D., M.P.H.
COMMISSIONER OF PUBLIC HEALTH

Environmental Engineering Service
P. J. Houser, M.S., P.E., Chief

15 May 1969

David D. Dominick
Commissioner, Federal Water Pollution
Control Administration
Washington, D.C. 20242

Attention: Murray Stein, Assistant Commissioner,
Office of Enforcement

RE: WATER QUALITY STANDARDS CONFERENCE, COUNCIL BLUFFS, IOWA SESSION

Enclosed is an answer to the Federal Water Pollution Control Administration rebuttal of the Iowa Water Pollution Control Commission Statement, page 11 (Missouri Basin) which we wish to have included in the official record of the Water Quality Standards Conference, State of Iowa, Council Bluffs Session.

The FWPCA biological data referred to had been collected in October and November 1968 but was not included in the Standards Conference Report.

Copies have been provided to the Regional Director, FWPCA, Missouri Basin Region.

R. J. Schliekelman, Director
Water Pollution Division

RJS/ab
Enclosure

ANSWER TO CONTINUATION OF FWPCA REBUTTAL OF IOWA WATER POLLUTION CONTROL COMMISSION'S STATEMENT, 1969, page 11.
(Missouri Basin)

Iowa's initial statement regarding the biological quality of the Missouri River was based exclusively on the biological data which was presented in Appendix B of the FWPCA's Missouri River Basin Report.

Since the data presented in the FWPCA rebuttal statement of April 30 was not included in the original report, it is obvious that the remarks in the initial Iowa statement were not directed toward the newly presented data and should not be interpreted as such.

It is recognized that quantitative biological sampling in a large river is difficult because of the habitat variety and that the shifting substrate which is typical of a large portion of the Missouri River, is unproductive biologically. The value of an artificial substrate sampler is also recognized as providing a quantitative estimate of numbers and kinds of biota.

Assuming that the numbers of organisms found at each of the three stations in the Sioux City area were obtained from equal numbers of substrate samplers, we would be in agreement that there is some evidence of biological degradation below the Sioux City discharge.

Whether this degradation at Station 723 is "severe" as stated by the FWPCA is debatable because species diversity in addition to total numbers of organisms is important as an indicator of biological quality. Although the number of pollution sensitive organisms was considerably decreased at station 723, the diversity or kinds of pollution sensitive organisms had not changed.

FOREWORD

The Water Quality Criteria and Plan for Implementation and Enforcement for the Surface Waters of Iowa was originally prepared for and submitted to the Department of the Interior in May, 1967.

Since that time, the numerous requests received from consulting engineers, educators and the general public have necessitated the publication of this revised edition.

The Criteria and Plan have been left unchanged. However, Table 11 has been updated to June 1, 1968.

INTRODUCTION

The Federal Water Quality Act of 1965, signed into law on October 2, 1965, required all states to develop water quality standards for the interstate streams within their state boundaries.

Revisions to the Iowa Water Pollution Control Law effective July 1965 established the Iowa Water Pollution Control Commission and the authority for adoption of water quality standards. The law provided the Commission with the authority to adopt, "such reasonable quality standards for any waters of the state......," and to "develop comprehensive plans and programs for the prevention, control and abatement of new, increasing, potential or existing pollution of the waters of the state."

After conducting seven public hearings throughout the state, the Iowa Water Pollution Control Commission adopted the Iowa Surface Water Quality Criteria Rules and Regulations on February 28, 1967. The Rules and Regulations were approved by the Attorney General of the Stata of Iowa on March 6, 1967 and by the Legislative Departmental Rules Review Committee on March 17, 1967. They were filed with the Secretary of State on March 20, 1967, and as provided by law, became effective 30 days thereafter.

The Implementation and Enforcement Plan for the Surface Water Quality Criteria was adopted by the Commission on May 26, 1967. The Surface Water Quality Criteria and the Implementation and Enforcement Plan have been combined and are called the Iowa Surface Water Quality Standards. The Standards as presented are the result of a joint effort of the Iowa Water Pollution Control Commission and the Iowa State Department of Health to abate pollution of the waters of the State of Iowa

TABLE OF CONTENTS

Introduction

Section I-General 1
  A. Topography 1
  B. Hydrology 1
  C. Flow Regulation & Augmentation 2
  D. Present & Future Uses - Iowa Waters 4
  E. Population 5
Section II - Surface Water Criteria 7
  A. Discussion of Criteria 7
    1. General Policy Considerations 7
    2. General Criteria 8
    3. Specific Criteria 9
      a. Public Water Supply 9
      b. Aquatic Life 11
      c. Recreation 11
  B. Surface Water Quality Criteria 13
  C. Compatability with adjoining states 17
Section III Implementation & Enforcement Plans 19
  A. Statutory Autority 19
    1. Statutes 19
    2. Rules & Regulations 21
  B. Enforcement Procedures 22
  C. Surveillance Program 23
    1. Operation reports 23
    2. Plant & operation surviellance 25
    3. Stream Surviellance 27
      a. Existing program 27
      b. Proposed program 28
    4. Existing water quality 29
  D. Pollution Control Programs 30
    1. Municipal & Industrial Waste Treatment 30
      a. Significant pollution sources 30
      b. Compliance with water quality 30
      c. Construction schedules 32
    2. Combined Sewer Overflow 33
    3. Agricultural waste waters 33
    4. Waste from boats and marinas 36
Section IV Public Hearings 37

Tables

  1. Low-Flow-10 year Recurrence 39
  2. Public Water Supplies 41
  3. Streams-Aquatic Life..Warm Water Areas 43
  4. Natural Lakes-Aquatic Life Warm Water Area . . . 45
  5. Artifical Lakes-Aquatic Life Warm Water Area . . 47
  6. Aquatic Life - Cold Water Areas 49

TABLE OF CONTENTS
(continued)

Tables...continued..

7. Recreation Areas-Streams Impoundments & Lakes ..51
8. Surface Water Sampling Stations-ABS-Pesticides-Radioactivity. 53
9. Surface Water Sampling Stations-Public Water Supplies-Major Cities. 55
10. Chemical Quality - Iowa Streams. 57
11. Status Waste Treatment Facilities. 59
Mississippi River Basin
Missouri River Basin
12. Municipal Sewerage Systems. 83

Figures

1. Monthly Coliform Average - Iowa River. 85
2. MPN Frequency Distribution - Iowa River. 87
3. Raccoon River Coliform Study. 89

SECTION I
GENERAL

A. TOPOGRAPHY OF IOWA

Iowa is situated in the Upper Mississippi River drainage basin, bounded on the east by the Mississippi River and on the west by the Missouri and Big Sioux Rivers. In general the surface shows but slight relief with the highest point in the northwest corner (1,675 feet) and the lowest point in the southeast corner (480 feet).

The entire state is drained by either the Mississippi River or its tributary, the Missouri River. The drainage areas are 38,860 and 17,379 square miles respectively.

Iowa streams entering the Mississippi River flow in a general course from northwest to southeast. The major drainage basins are long and narrow and have fairly regular outlines with the lateral boundaries tending to be parallel.

The stream drainage basins which drain into the Missouri River are also relatively long and narrow and extend from the northeast to the southwest. They lie nearly perpendicular to those streams tributary to the Mississippi River.

B. HYDROLOGY

A seven-day, ten-year low flow has been selected to recognize the variability of Iowa stream flows in the application of water quality criteria and in the economic analysis and evaluation of treatment requirements. There also exists a tremendous variability in Iowa streams with reasonably well sustained low flows, from ground water, in northeast Iowa and decreasing progressively to the south and west portions of Iowa. A review of Table 1, taken from Low Flow Characteristics of Iowa Streams, Bulletin No. 9, Iowa Natural Resources Council 1958, shows this variation quite clearly.

HYDROLOGY....continued

With the exception of upland portions and minor tributaries the northeast Iowa basins including the Iowa-Cedar basins have seven-day, ten-year low flow values in the range of 0.04 to 0.08 cubic feet per second (cfs) per square mile. The remainder of the streams in the state, south and west of the Iowa-Cedar basins, have very poor low flow characteristics. No stream in this area of the state has a flow above 0.01 cfs per square mile, for the seven-day, ten-year low flow magnitude. Many streams have less than one-half this value.

For a specific example, the seven-day, ten-year low flow for the Cedar River at Cedar Rapids is compared in the following table, to the Des Moines River at Boone which has a comparable drainage area.

	Drainage Area Sq. Miles	Yield cfs/sq. mile	10 year-7-day Flow-cfs
Cedar River at Cedar Rapids	6510	0.047	306
Des Moines River at Boone	5511	0.0065	36

For an equivalent drainage of 6510 square miles, the Des Moines River basin would yield 42 cfs as compared to 306 cfs for the Cedar River or only one-seventh of the comparable flow of the Cedar River. A similar comparison indicates that the Upper Iowa River has a seven-day ten-year low flow approximately 200 times that of the Skunk River at Ames, with somewhat comparable drainage areas.

C. FLOW REGULATION AND AUGMENTATION

The Surface Water Quality Criteria for the waters of the State of Iowa are related to and affected by the existing flows in the streams. It is, therefore, important that governmental controls be exercised where applicable to maintain adequate flows in these streams.

The Iowa Natural Resources Council, the state agency responsible for administering the water use permit system, has adopted a policy that water use permits

FLOW REGULATION AND AUGMENTATION...continued

will not be granted for the withdrawal of water for consumptive use which will reduce the flow in the stream below a given amount. The cut-off point below which no consumptive withdrawals can be made is generally much higher than the seven-day, ten-year low flow used as a basis for the Water Quality Criteria application.

The principal consumptive uses from streams that are being regulated are withdrawals for supplemental irrigation and for filling of off-stream reservoirs.

When deemed necessary to protect downstream uses, storage permits require the release of that portion of the natural flow into the reservoir that is required to prevent material damage to downstream uses. In special circumstances, installation of facilities for the release of certain minimum flow is included in the storage permit.

Soil conservation and soil management programs controlling farmland runoff tend to increase ground water reserves, thereby augmenting low flow when the main source of flow is ground water. With increasing soil management programs this effect might be further realized in the future.

The Iowa Water Pollution Control Commission endorses the flow regulation policies of the Natural Resources Council and all other programs designed to prevent soil erosion and retain farmland runoff and therefore maintain a greater flow in the state streams. Maintenance of higher flows in streams will provide for additional beneficial uses to be supplied by these streams.

A number of multiple purpose reservoirs have been constructed or authorized in Iowa. These will generally provide benefits for flood control, water quality control, water supply, recreation, and fish and wild life. Reservoirs presently constructed or planned with storage for water quality control will benefit only four major cities.

D. PRESENT AND FUTURE USES OF IOWA WATERS

The surface waters of the state are currently being used in the following ways: municipal water supply, industrial water supply, livestock watering, fish propogation, recreation, wildlife habitat and irrigation.

These uses are relatively uniform throughout the state. The use of these stream resources for their full potential is hampered mainly because of the great variability of flow and high turbidities occuring in these streams during certain times of the year.

Currently there are 39 municipalities using surface water sources for public water supply use. It is not anticipated that new surface water supplies will be developed in the near future although it is expected that eventually some municipalities may need to change from underground sources to more adequate surface supplies.

The demand for increasing the fishery resources throughout the state will be constantly enlarged due to the emphasis put on outdoor recreation and also the increasing amount of leisure time available. Fisheries in Iowa have been considerably restricted due to heavy siltation and variable flows in the majority of Iowa streams. Enhancement of the fishery resources by stream and land management will, in itself, increase the demand for this resource.

Activities enhanced by water are camping, hiking and picnicking. The principal water based recreational activities are fishing and boating. Water skiing and swimming is generally limited to natural lakes and impoundments created by dams, including the Mississippi River and swimming is generally limited to the artificial lakes. The demand for recreational use of surface water is increasing and it is anticipated that the demand will be met by construction of artificial impoundments.

All surface waters of the state are used at least to a limited extent for livestock watering and wildlife propogation. Presently agricultural use is basically livestock watering with limited supplemental irrigation practiced.

E. POPULATION

Iowa's population has been increasing at a substantially slower tate than the national population since 1900. Because of farm consolidation and mechanization, many rural trade centers have lost population and trade volume, and the larger urban centers have experienced growth in population and in service and manufacturing employment. Population and employment projections indicate eastern Iowa will experience the greatest growth in these areas.

SECTION II

IOWA SURFACE WATER QUALITY CRITERIA

A. DISCUSSION OF CRITERIA

The Iowa Water Pollution Control Commission, pursuant to authority granted in Section 455B.9 and 455B.13, Code of Iowa 1966, has adopted Rules and Regulations governing Surface Water Quality Criteria for the State of Iowa. These criteria of water quality are intended as guides for determining the suitability of surface waters in the State of Iowa for various uses, and to aid decision making in the establishment of waste control measures.

Following is a discussion of the Water Quality Criteria which is presented in paragraph B of this Section. The discussion is divided into sections corresponding to those of the Rules and Regulations.

1-Sec. 2.1 General Policy Considerations

The surface waters of Iowa have been classified as to designated legitimate uses by the Water Pollution Control Commission. The classifications of Iowa Waters are found in tables 2, 3, 4, 5, 6 and 7 listing the public surface water supplies, streams and lakes, designated as fishing areas, and lakes and impoundments designated as recreation areas. Table 11 in Section III enumerates the water use criteria at the municipal and industrial waste discharge points.

The water quality for the designated uses will comply with the criteria at:

1. The raw water intake for Public Water Supply Use.
2. All points in the stream from the mouth up to the designated cutoff point as well as all artificial and natural lakes for Aquatic Life Use.
3. All points in the recreation pool for Recreation Use.

Sampling to determine conformance to these criteria shall be done at sufficient distances downstream from waste discharge points to permit adequate mixing of waste effluents with the surface waters. In the performance of tests or analytical determinations to determine compliance with the established surface water criteria, samples will be collected at such locations, times, frequencies, and in such a manner as approved by the Commission.

1-Sec.2.1 General Policy Considerations..continued

The collection, preservation, and testing of samples will be made in conformance with the methods given in the latest edition of "Standard Methods of the Examination of Water and Sewage." Where more than one method is prescribed, that method designated by the Commission shall be used. Any methods deviating from those prescribed must be approved by the Commission.

2. Sec. 2.2 General Criteria

The General Criteria shall apply to all water courses and lakes at all times. For designated water use areas, the General Criteria will be supportive to the specific criteria applicable to these areas. Where a surface water has not been designated for a specific water use, these criteria will govern. The General Criteria shall be interpreted to mean that no raw or treated wastes, attributable to municipal, industrial or other sources, shall be discharged into any waters of the state which will produce putrescent or otherwise objectionable sludge deposits, floating debris, oil slicks, scum, odors, color, chemical concentrations or combinations to such a degree as to be detrimental or harmful to legitimate downstream water uses.

In general, those small intermittent streams experiencing low or zero flows or which cannot under natural conditions support a permanent fish population, will have their quality governed by the General Criteria. It is the intent of the General Criteria to protect the water quality in these areas for the letitimate uses to which they are presently being used. Legitimate uses in this category are those such as: irrigation, livestock watering, wildlife propogation, etc. To protect these uses on low flow streams, the wastes will be given the highest practicable degree of treatment without respect to dilution in order to prevent the development of nuisance or health problems below the discharge. The requirements are such that the effluent will be suitable for limited downstream use. Treatment less than secondary will not be accepted unless it can be shown that the legitimate uses can be protected with a lesser degree of treatment.

3. Sec. 2.3 Specific Criteria for Designated Water Uses

The criteria in this subsection apply to the water use areas designated by the Water Pollution Control Commission. The designation has been made by the Commission with the advice and assistance of the Iowa Natural Resources Council, State Conservation Commission, State Department of Health, public hearing testimony, the faculties of the three state universities and other interested parties. The designation does not limit beneficial uses or prohibit beneficial uses other than those listed.

The minimum weekly flow which occurs once in ten years shall be used as the design parameter to determine the degree of treatment necessary to protect the specific water use. Flow will be based on a statistical analysis of existing flow data, if such data are available. This specific surface water criteria shall be met at all times when the flow exceeds the ten year low flow. When the flow is less, the municipality or industry shall not be held responsible for lower stream quality when their waste effluent is receiving the necessary degree of treatment or control to comply with criteria at the ten-year low flow.

The extreme variability of low flow at the seven-day ten-year magnitudes in Iowa streams has been given consideration in the application of the criteria to designated water areas. The natural water quality may be degraded naturally by the aquatic environment at these low flows. It must be recognized that at the selected low flow probability, many municipalities in central, southern and western Iowa will be discharging treated municipal waste water into essentially dry streams.

a. Public Water Supply

This criteria has been developed to protect the quality of the influent raw water for the 39 existing surface water supplies and will be applied to any future supplies. The designated surface waters where the Public Water Supply Criteria apply are listed in Table 2.

a. Public Water Supply...continued....

Numerical bacterial limits have not been specified because of the following reasons:

1. The Standard Coliform organisms found in streams are not specific for human sources but members of this group are found in enteric discharges of warm-blooded animals, and in the guts of cold-blooded animals, in soils and in many plants.

2. Bacterial studies have shown that commonly acceptable coliform levels have been greatly exceeded in the absence of wastes attributable to human sources.

If a stream contains coliforms that are of a domestic sewage origin one might expect the most probable number (MPN) to vary inversely with the dilution capacity of the stream and that high MPN values would be expected during the dry seasons. A long term coliform study on the Iowa River at Iowa City, beginning in 1950, indicates high bacterial densities are associated with high stream flows and turbidity. Due to intense farming in the drainage basin, each snow melt or rainfall carries into the river large quantities of silt and apparently large number of coliform organisms from the agricultural land. Sanitary sewage is not considered a significant factor since the nearest town is approximately 30 miles upstream.

Figure 1 illustrates the pattern, on a monthly average basis, of the direct relationship of increasing stream flows accompanied by increases in both turbidity and coliform density. Figure 2 indicates that the monthly coliform MPN average is less than 5000 per 100 m/l about 46% of the months samples, both before and after impoundment above the supply in 1958.

Much data are available from other studies and sources to substantiate the influence of land runoff on coliform densities. Figure 3 includes additional data.

For the above reasons, the Commission has specified that a sanitary survey be conducted with the results being evaluated according to the particular situation investigated.

a. Public Water Supply...continued

When a source of coliform bearing waste which can be feasibly controlled is affecting the suitability of a water supply the Commission may use the following values as a guide: Coliform organisms are not to exceed a MPN or MF of 5000/100 ml as a monthly average value, nor to exceed this value in more than 20% of the samples examined during any one month nor to exceed 20,000/100 ml in more than 5% of the samples examined in any one month. This value may be used as a guide until suitable indices can be developed.

b. Aquatic Life

In the classification of surface waters, all lakes and perennial streams capable of supporting a permanent fish population have been designated for Aquatic Life Use.

These areas have been designated by the Water Pollution Control Commission with the advice and assistance of the Iowa State Conservation Commission and others. The warm water areas are those streams and stream reaches delineated in Table 3 and the natural and artificial lakes listed in Tables 4 and 5.

The cold water areas are those waters designated by the Commission as trout streams and are those which are annually stocked with trout on a "put and take" basis, by the State Conservation Commission. These areas are listed in Table 6 which is a summary of the current "Guide to Iowa Trout Waters" published by the State Conservation Commission.

The criteria list only those factors which appear to be of utmost importance to the preservation of a well-balanced fish population. However, all other waste constituents that are determined harmful to the stream aquatic life will also be subject to control by the Commission.

c. Recreation

The recreational use criteria are designed to reasonably protect surface waters where the whole body contact sports of swimming and water skiing are concentrated during the recreational season.

c. Recreation...continued

Use of lakes and streams constitute a much greater drowning hazard to the swimmer than the supervised swimming pool due to the lack of water clarity, presence of hidden obstructions or strong currents, but it is the intent to provide a reasonable bacterial water quality for the natural bathing areas.

Information provided from other state agencies, presentations at the public hearings, etc., was used by the Commission to designate the Recreation Use areas on lakes and Federal impoundments. These areas are listed in Table 7. The Recreational Use areas have also been classified for Aquatic Life Use since these two uses are closely related to each other and require a high quality of water.

No numerical values have been specified for bacterial limits since studies have shown high bacterial concentrations associated with land runoff, and public health studies to date have shown little direct correlation between coliform concentrations and water-borne diseases. Supportive data collected from Iowa streams showing high background coliform counts are shown in Figures 1 and 2.

Where a controllable waste discharge is the proven source of increased bacterial concentrations, the Commission may use the following as a guide: The arithmetical mean coliform density is not to exceed 1,000 per 100 ml as a monthly average nor exceed this value in more than 20% of the samples in any one month nor exceed 2,400/100 ml in any one sample. This value will be used as a guide until suitable indices can be developed.

Where a significant coliform or other bacterial increase in a designated Recreation Use Area can be identified with a controllable waste discharge, chlorination or other control procedures to reduce the bacterial concentration below the guide limits may be required.

B. SURFACE WATER QUALITY CRITERIA

The following rule and regulation was adopted by the Iowa Water Pollution Control Commission on February 28, 1967.

IOWA WATER POLLUTION CONTROL COMMISSION
RULES AND REGULATIONS
WATER QUALITY STANDARDS

Pursuant to the authority of sections 455B.9 and 455B.13, Code of Iowa, 1966, the water quality standards found in the July, 1966, Supplement, Iowa Departmental Rules, page 70, are hereby amended by adding the following to Chapter 1.

Section 1.2. (455B) Surface water quality criteria.

1.2(1) General policy considerations. Surface waters are to be evaluated according to their ability to support the legitimate (beneficial) uses to which they can feasibly be adapted, and this specific designation of quality areas shall be done by the Iowa Water Pollution Control Commission.

Sampling to determine conformance to these criteria shall be done at sufficient distances downstream from waste discharge points to permit adequate mixing of waste effluents with the surface waters.

1.2(2) General criteria. The following criteria are applicable to all surface waters at all places and at all times:

a. Free from substances attributable to municipal, industrial or other discharges that will settle to form putrescent or otherwise objectionable sludge deposits;

b. Free from floating debris, oil, scum and other floating materials attributable to municipal, industrial or other discharges in amounts sufficient to be unsightly or deleterious;

c. Free from materials attributable to municipal, industrial or other discharges producing color, odor or other conditions in such degree as to be detrimental to legitimate uses of water;

d. Free from substances attributable to municipal, industrial or other discharges in concentrations or combinations which are detrimental to human, animal,

B. Surface Water Quality Criteria....continued

industrial, agricultural, recreational, aquatic or other legitimate uses of the water.

1.2(3) Specific Criteria for designated water uses. The following criteria are applicable at flows greater than the lowest flow for seven consecutive days which can be expected to occur at a frequency of once every ten years.

a. Public water supply. The following criteria for surface water quality apply to the point at which water is withdrawn for treatment and distribution as a potable supply:

(1) Bacteria: Waters shall be considered to be of unsatisfactory bacteriological quality as a source when:

A sanitary survey indicates the presence or probability of the presence of sewage or other objectionable bacteria-bearing wastes or

A bacteriological survey using coliform or other appropriate indices indicates bacteriological concentrations significantly higher than those normally found or expected in these waters when free from pollution by sewage.

(2) Radioactive substances: Gross beta activity (in the known absence of strontium - 90 and alpha emitters) not to exceed 1000 micro-micro-curies per liter.

(3) Chemical constituents: Not to exceed the following concentrations:

Specific Constituents (mg/l)

Arsenic	0.05	Cyanide	0.025
Barium	1.0	Fluoride	1.5
Cadmium	0.01	Lead	0.05
Chromium(hexavalent)	0.05	Phenols	0.02

All substances toxic or detrimental to humans or detrimental to treatment processes shall be limited to nontoxic or nondetrimental concentrations in the surface water.

b. Aquatic life. The following criteria are designed for the maintenance and propagation of a well-balanced fish population. They are applicable to any place in surface waters but cognizance will be given to opportunities for admixture of waste effluents with such waters.

(1) Warm water areas. Dissolved oxygen: Not less than 5.0 mg/l during at least 16 hours of any 24-hour period and not less than 4.0 mg/l at any time during the 24-hour period.

pH: Not less than 6.8 nor above 9.0.

Temperature: Not to exceed 93°F during the months of May through November, and not to exceed 73°F during the months of December through April.

Chemical constituents: Not to exceed the following concentrations:

Specific constituents (mg/l)

Ammonia Nitrogen (N)	2.0	*Copper	0.02
*Arsenic	1.0	Cyanide	0.025
*Barium	5.0	*Lead	0.10
*Cadium	0.05	Phenols	0.20
*Chromium(hexavalent)	0.05	*Zinc	1.0
*Chromium(trivalent)	1.00		

*A maximum of 5.0 mg/l for the entire heavy metal group shall not be exceeded.

All substances toxic or detrimental to aquatic life shall be limited to nontoxic or non-detrimental concentrations in the surface water.

(2) Cold water areas. All criteria stated for warm water areas apply to cold water areas except as follows:

Dissolved oxygen: Not less than 7.0 mg/l during at least 16 hours of any 24-hour period nor less than 5.0 mg/l at any time during the 24-hour period.

Temperature: No greater than 70°F.

c. Recreation. The following criteria are applicable to any waters used for recreational activities involving whole body contact such as swimming and water skiing:

(1) Bacteria: Waters shall be considered to be of unsatisfactory bacteriological quality for the above recreational use when:

A sanitary survey indicates the presence or probability of the presence of sewage or other objectionable bacteria-bearing wastes or

A bacteriological survey using coliform or other appropriate indices indicates bacteriological concentrations significantly higher than those normally found or expected in these waters when free from pollution by sewage.

These rules are intended to implement sections 455B.9 and 455B.13, Code of Iowa, 1966.

These rules shall become effective as provided in Chapter 17A of the Code after filing in the office of the Secretary of State after review by the Departmental Rules Review Committee.

EXAMINED AND APPROVED

DATE March 6, 1967
/s/ Fred Henderickson
ATTORNEY GENERAL

DATE ADOPTED February 28, 1967
/s/ Robert Buckmaster
DEPARTMENT HEAD

REVIEWED AND APPROVED

DATE March 17, 1967

/s/ Adolph W. Elvers
CHAIRMAN, DEPARTMENTAL RULES
REVIEW COMMITTEE

C. COMPATABILITY WITH ADJOINING STATES

Notices of public hearings and proposed water quality data for Iowa streams were submitted to the adjoining states of Nebraska, South Dakota, Minnesota, Wisconsin, Illinois and Missouri. Representatives from Minnesota attended one hearing, Illinois - two hearings, and Missouri - two hearings. Oral and written statements were presented at the hearings.

The content and general requirements of the standards were discussed at specific meetings with the states of Illinois and Missouri as early as December 1965. Correspondence and discussion have been carried on with all adjoining states.

Iowa representatives attended one hearing in Wisconsin, two in Illinois and two in Missouri and oral and written statements regarding general consistency and compatability of the criteria were submitted. The water quality criteria and uses for the common waters between Illinois and Iowa are identical. The entire Iowa Water Pollution Control Commission attended one hearing in Illinois.

Reasonable agreement has also been reached with all states as to the water uses to be made of common interstate waters.

Following study of the testimony submitted at the public hearing the Commission ammended a number of the water quality criteria parameters. The phenol concentration was increased to a more attainable and realistic figure and the cyanide concentration for the public water supply used was reduced to correspond to the aquatic life concentration. The temperature limit for the warm water areas was reduced slightly to 93° as a more generally accepted figure and provision was made to prevent extreme temperature changes.

SECTION III

IMPLEMENTATION AND ENFORCEMENT PLAN

Objective

The purpose of the plan is to provide a means by which the water quality criteria can be enforced and the quality of surface waters protected and enhanced for beneficial uses. The plan has been developed to protect all surface waters and not only interstate waters as required by the Federal Water Quality Act of 1965.

A. STATUTORY AUTHORITY

The Water Pollution Control Commission and the State Department of Health make use of the following authority to control or abate pollution of the surface waters of the state.

1. STATUTES

Iowa Water Pollution Control Commission

Specific statutory authority for the Iowa Water Pollution Control Commission for adoption and enforcement of water quality criteria is found in Chapter 455B, Code of Iowa, 1966. Exerpts of the law pertaining to the authority follow:

455B.3 There is hereby created and established the Iowa Water Pollution Control Commission. The Commission is established as an agency of the state government to prevent, abate, or control the pollution of the waters of the state.

455B.9 The Commission is hereby given and charged with the following powers and duties:

1. The Commission through the State Department of Health shall have general supervision over administration and enforcement of all laws relating to the pollution of any water of the state, except as provided in Section 135.11 of the Code.

1. Statutes...continued

2. To develop a comprehensive plan and program for the prevention, control and abatement of new, increasing, potential or existing pollution of the waters of the state.

3. The Commission may cause the State Department of Health to conduct investigations....

4. To adopt, modify, or repeal such reasonable quality standards for any waters of the state in relation to the public use to which they are or may be put as it shall deem necessary for the purposes of this Act.

6. To direct the State Department of Health to issue, revoke or modify permits......for the discharge of sewage, ... or for the installation or operation of disposal systems....

8. To prescribe rules and regulations....

9. The Commission shall cooperate with other state or interstate water pollution control agencies in establishing standards, objectives, or criteria for quality of interstate waters. . . .

455B.10. The State Department of Health shall conduct such investigations as may be necessary to carry out the provisions of the Act.

455B.11 The State Department of Health in accordance with the direction and policies of the Commission may issue, modify, or revoke such orders as may be required for the prevention or discontinuance of the discharge of sewage,industrial waste or other waste in any waters of the state resulting in pollution in excess of the applicable quality standard....

Iowa State Department of Health

Section 135.11, paragraph 7, Code of Iowa, requires that the State Department of Health shall "make inspections of ...., sewer systems, sewage treatment plants,.... and direct the method of installation and operation of the same."

Mandatory Certification

Chapter 136A, Code of Iowa, 1966, is an act to certify all public Water Supply Systems and Waste Water Treatment Systems and require the examination of operators and certification of their competency to supervise the operation of these facilities.

Miscellaneous Statutory Provisions

Section 732.3 declares that it is unlawful to throw any dead animal, night soil, or garbage into any river, well, spring, cistern, reservoir, stream or pond or in or upon any land adjoining which is subject to overflow.

Section 657.2(4) declares it is a nuisance to corrupt or render unwholesome or impure the water of any stream, river or pond.

2. RULES AND REGULATIONS

Rules and Regulations have been approved as authorized by the statutes and have the full effect of law.

Municipal Effluent Standard

This rule requires that no municipality shall discharge any sewage to the waters of the state without effective removal of floatable and settleable solids as the minimum degree of treatment.

Surface Water Quality Criteria

This rule and regulation is discussed and given in Section II, Paragraphs A and B.

Records of Operation of Waste Disposal Systems

This joint rule of the Water Pollution Control Commission and State Department of Health requires all owners of waste disposal systems to submit monthly operation reports to the State Department of Health.

Certification of Water Supply System and Waste Water Treatment Plant Operators

This rule of the State Department of Health classifies waste water treatment plants and establishes operator education and experience qualifications.

B. ENFORCEMENT PROCEDURES

To accomplish pollution abatement four different methods of action can be instigated by the Iowa Water Pollution Control Commission to abate pollutional conditions:

1. The Commission may direct the State Department of Health to conduct an investigation of alleged pollution. If the Commission finds that pollution exists, a negotiation meeting is arranged between the Commission and the alleged pollutor. If agreeable to both parties, a time schedule of pollution abatement is arranged and a consent order is drawn by the Commission and signed by both parties.

   If a satisfactory agreement as to a construction time schedule cannot be reached between the Commission and the alleged pollutor, a hearing is ordered by the Commission as provided by law. If the evidence presented indicates that pollution does exist, the Commission issues an order to abate the pollution within a reasonable period of time.

2. If a municipality is discharging raw or inadequately treated wastes to a state water, the Commission notifies the municipality that they are in violation of the state effluent standard requiring a minimum removal of settleable and floatable solids. A negotiation proceeding or hearing follows as in the first method except that an investigation is not required.

3. If a municipality or industry is operating a waste treatment plant which is in violation of a permit issued by the Health Department for its installation, the State Department of Health initiates legal action through the Attorney General's Office. The Attorney General notifies the municipality or industry to take appropriate action to comply with the stipulations of the permit.

4. The permit provision of the law provides that permits for extensions to existing sewer systems can also be denied where a condition of pollution already exists below the outlet, unless active planning is underway for the installation of treatment facilities.

C. SURVEILLANCE PROGRAMS

Routine monitoring of waste discharges will be accomplished in three ways: (1) operation reports, (2) plant and operation surveillance, (3) stream surveillance.

1. Operation Reports: Rules and Regulations have been adopted which require monthly submittal of operation reports by all owners of waste disposal systems which discharge sewage or wastes into any waters of the state. Where practicable the Commission will require the larger treatment facilities to initiate a downstream sampling program.

Five different operation report forms are now being used. These are differentiated according to the type of waste disposal system:

WWTR I	Waste Stabilization Lagoon
WWTR II	Imhoff and Trickling Filter
WWTR III	Trickling Filter..Separate Sludge Digestion
WWTR IV	Extended Aeration
WWTR V	Industrial Lagoon

Checking the data and actual monitoring of the waste disposal plant will be done by data processing equipment. The equipment to be used is the state's IBM 360-40 computer, which is to be replaced by a 360-65 in the future. On order, but not yet received, is an IBM 360-20 computer which will be used more directly by the Health Department.

A description of the computer monitoring process follows:

Each incorporated city or town has been given a code number according to alphabetical listing. All waste producers in the locale of a municipality have been given the town number. The waste producers are further classified as to type:

1. Municipality
2. Industry
3. Mobile Home
4. School
5. Recreational
6. Commercial
7. Sanitary District

1. Operation Reports...continued

The discharge of the waste is further classified as to:

1. Treated to City Sewer
2. Untreated to City Sewer
3. Treated to State Waters
4. Untreated to State Waters
5. Raw to Another Municipality
6. Raw to a Sanitary District
7. No recognized Sewer System

Explanation of Card Information:

Card 1.	Plant location information and design data.
Card 2.	Operator in direct responsibility number, type of treatment and construction and improvement data.
Card 3.	Status of the plant according to Commission actions with orders and time schedule for pollution abatement.
Card 4.	Permits for sewer extensions with sizes and lengths.
Card 5.	Operational data required and limits set on parameters.

The computer will check on each plant according to:

1. Receipt of operation report.
2. Compliance of submitting required data.
3. Data complying with loading or effluent limits established.

Every treatment plant requiring operation reports will receive a monthly statement acknowledging receipt of the report and compliance or ommission of required data. It is felt that monthly communication with the operator is of prime importance to insure adequate report submittal. The statement will also indicate if any of the parameters have exceeded the limits established.

Periodically, the computer will check on the plants to determine if the design parameters are being exceeded. Action will be initiated to update the waste treatment plant with overloaded facilities. The computer system will, therefore, be able to determine current pollution conditions and future pollution due to overloading of the plant facilities. The waste treatment plant owners will be notified that plant improvements are needed and encouraged to take appropriate corrective action.

The base files in the storage system will be continually updated to provide more adequate information on which to judge operation and facility adequacy.

2. Plant and Operation Surveillance:

The plant and operator surveillance programs of the state are aimed to check the operation, maintenance and efficiency of the treatment plants and to increase the competency of the operators in charge of these plants. To achieve these goals the State Department of Health has in effect the following programs:

a. Treatment Plant Inspection

The State Health Department field engineers located in seven regional offices situated throughout the state periodically inspect all the waste treatment plants in the state. Reports stating the condition of the receiving stream, plant operation, performance and recommendations for improvements are transmitted to the responsible municipal or industry officials. Pertinent data from this report will also be used to update the computer records on each treatment plant. The regional engineers also offer advice and assistance to the treatment plant operators on plant operation procedures, report completion, laboratory procedures or other problems concerning their plant.

b. BOD Mailing Program

In May of 1967 the State Hygienic Laboratory, in conjunction with the State Department of Health, began the BOD Mailing Program. This program enables BOD samples to be collected in the field and mailed to the State Hygienic Laboratory without refrigeration. To facilitate this procedure samples are acid fixed directly upon collection and then neutralized and seeded following return shipment to the laboratory. Laboratory studies showed that results were reproducible with sufficient accuracy to use the field BOD samples as a check on the plant effluent strength.

Initally, the BOD samples will be collected by the treatment plant operators upon receipt of request from the State Hygienic Laboratory. Each plant effluent will be sampled at least four times yearly. As the program develops, the regional engineers will also be equipped to collect additional samples during their plant surveys to gain additional data concerning the treatment facilities and final plant effluent. A future possibility of the

BOD Mailing Program if additional personnel and equipment are available, might be to permit treatment plants to submit BOD samples for analysis on a fee basis.

The laboratory BOD results will be tabulated on a computer coded card and then stored in the data storage record for each plant. The results will be analyzed by the computer and results compared to previous samples and any limits placed on the effluent. The BOD results will be included in the monthly operation report analysis sent to the plant operator. The BOD Mailing program will thus faciltate the continual monitoring of the waste treatment plant effluents and check the operational report data submitted.

c. Operator Competence

Mandatory Certification - To support the plant operation surveillance the General Assembly enacted a Mandatory Certification Law, effective in July 1965. Operators in direct responsibility of public waste water treatment plants must be certified. Education and operational experience and a comprehensive examination are graded according to the classifiication of the certificate. Certificates are classified as to complexity, type and size of plant. All municipalities have complied.

Operator Basic Training Courses - Basic training courses have been conducted since 1952 when a Voluntary Certification Program was initiated. With the enactment of the Mandatory Certification Law six courses for approximately 30 persons each, (3 hours per week for 9 weeks) have been held annually with instruction furnished primarily by the two Universities. Plans are being developed for an advanced course for the larger and more complex plants.

Laboratory Course - Currently a laboratory course for treatment plant operators is being conducted yearly at Iowa State University in Ames. This program will need expansion and plans are being made to arrange funds and facilities to meet this need. Advanced laboratory control courses and seminar are being planned at the University of Iowa and the State Hygienic Laboratory.

Laboratory Course..continued

It is felt that through the mandatory certification program and the operator training couses, the overall competence of the operators throughout the state will be greatly increased. Increased operational efficiency, accomplished by operator training will greatly benefit the State surface waters.

3. STREAM SURVEILLANCE

a. Existing program

The State of Iowa is currently carrying on the following surface water surveillance programs:

Municipal Water Supplies - Currently 29 surface water sources of municipal water supplies are being surveyed of which 15 are located on interstate streams. Samples are being collected semi-annually by local officials and the following analyses are made by the State Hygienic Laboratory.

COD
Nitrogen cycle
Solids
pH
Hardness
PO_4 (Soluble)
PO_4 (Total)

NA
K
CA
Mg
Fe
Mn
F

Cl
SO_4
HCO_3-CO_3
Silica
Specific conductance

ABS Six stream locations are under surveillance for ABS.

Pesticides Pesticide surveillance began in 1965 and is presently being expanded to include smaller streams in the state. Currently chlorinated hydrocarbons are being analyzed at six stream locations.

Radioactivity Alpha and beta-gamma activity are being determined on the total, dissolved and suspended solids of the surface waters at 15 stream locations, 2 lake locations and 3 impoundments. These samples are collected on a monthly schedule.

W.P.C. Surveillance Network River stations are being sampled generally on a monthly basis for the Water Quality Surveillance System at Dubuque, Burlington and Omaha. Sample Analyses include: plankton, radioactivity, delayed incubation membrane coliform tests, and extensive elemental and compound determinations.

Taste and Odor The Missouri River Public Water Supply Association has furnished data on extensive taste and odor studies relative to the Missouri River. Studies were conducted on the Boyer, Soldier, Maple and Missouri Rivers.

Cedar River research studies on biological precursors of oderiferous compounds have been in progress since 1961. The Des Moines River is also receiving similar surveillance because of "fish taints". The State Hygienic Laboratory is conducting the research in conjunction with the State Conservation Commission, the Iowa State Department of Health and the Water Pollution Control Commission.

b. Proposed program

In addition to the current surveillance programs, the Iowa Water Pollution Control Commission plans the addition of 66 new surface water sampling stations. The initiation of these new stations and the frequency of sampling depends upon financing and facilities being made available.

These proposed stations will survey additional reaches of streams and the downstream conditions below waste water treatment plant outlets. Initially it is proposed that samples be collected semi-annually with the following analyses being made:

BOD
COD
NH_3cycle
D. O.
Solids

Turbidity
Temp
pH
PO_4(Total)
PO_4(Soluble)

Heavy metals*
F*
Phenols*
Cyanide*

*Analysis at less frequent intervals

The designated recreational and water supply areas which are downstream from a significant bacterial waste discharge will be sampled with the help of local participation.

b. Proposed program....continued

Coordination of the Stream Surveillance Program will be accomplished with other agencies also concerned with stream quality. Those agencies are:

1. U. S. Geological Survey
2. Corps of Engineers
3. State Conservation Commission
4. State Universities
5. Bordering states
6. Public water supplies

By law the State Hygienic Laboratory provides laboratory services for the Commission and the Health Department. The Laboratory has the facilities and qualified personnel to perform the necessary analyses required by the state in its current surface water surveillance program. However, expansion of the Laboratory staff and facilities will most likely be necessary when the proposed surveillance program is initiated.

The locations of the existing and proposed sampling stations for the various parameters involved in the surveillance of waters of the state are tabulated in Tables 8 and 9.

4. Existing Water Quality

The existing quality of a major portionof Iowa surface waters is considered satisfactory for the present and future water uses. It is the opinion of the Water Pollution Control Commission that as a minimum effect the Surface Water Quality Criteria will maintain the quality of those waters currently in satisfactory condition and upgrade those waters of lower quality to support the designated legitimate beneficial uses.

Table 10 is a tabulation of the data from one of the existing water quality surveillance programs collected over the past five (5) years.

4. Existing Water Quality....continued

In addition to the regular sampling stations, there has been extensive miscellaneous sampling in routine pollution investigations below municipalities and also entire stream reaches. These samplings have generally included pH, DO, BOD and Coliform MPN. These data are not presented since they are not easily retrievable and because the pollutional conditions have since been or are in the process of being corrected.

D. WATER POLLUTION CONTROL PROGRAMS

The following is a summary of the Water Pollution Control Commission policies and programs to control and abate pollution:

1. Municipal and Industrial Waste Treatment

a. Significant Pollution Sources

A listing of the significant pollution sources to surface waters is shown in Table 11. This table divided into the Mississippi and Missouri River Basins lists the municipalities and major industries, the type of treatment provided, the treatment needs and a time schedule for construction of needed facilities. These listings will change as new facilities are provided and existing facilities depreciate or become overloaded.

This table also lists the downstream water uses which have been categorized in the water quality criteria. Any reach of stream not designated for a specific water use will have its water quality governed by the general criteria. The numerical listings represent the following specific water use criteria:

1. Public water supply (point of withdrawal)
2. Aquatic life - Warm water area
2a. Aquatic life - Cold water area
3. Recreation
4. General Criteria

b. Compliance with Water Quality Criteria

Table 11 also presents the best estimate of treatment needs. All municipalities on interior streams will generally need secondary treatment and some already have two stage filtration or other tertiary treatment furnishing up to 96% BOD removal.

b. Compliance with Water Quality Criteria...continued...

At the present time the Missouri River is in compliance with the criteria since the water quality is not degraded by the discharge of wastes receiving primary treatment due to dilution presently afforded. A greater variety of beneficial water uses on the Mississippi river necessitates coliform reduction in addition to primary treatment. Generally a lesser degree of treatment than secondary on these two large streams will not effect the water quality criteria due to the great dilution available.

The characteristics of a receiving stream, including its seven-day ten-year probable low flow, will continue to be used in determining the type of treatment needed. Treatment less than secondary will not be accepted on low flow streams unless it can be shown that legitimate uses can be protected with a lesser degree of treatment.

All industries will be required to provide the same degree of treatment or control that is required of municipalities on the same reach of the stream. This degree of treatment will generally be the equivalent of secondary treatment. A more complete inventory of industrial plants and their pollution producing potential is underway.

Table 12, showing the Municipal Sewerage Systems in Iowa as of December 31, 1966 presents some of the treatment needs. 97.6% of the sewered population is provided with treatment facilities and the majority of the remaining 39 communities with a combined population of 42,427 are under orders to provide treatment. It will be noted 466 communities out of the total of 944 do not have community sewer systems. The majority of these communities are under 500 population (average 280 pop.) and do not present serious pollution problems. Federal financing programs have stimulated great interest in sewer systems and treatment facilities among these small communities.

Knowledge regarding the extent of pollution caused by nutrients from sewage treatment plants is limited and may be relatively insignificant compared with nutrients from land wash. Further research in both areas is necessary before considering a time schedule for nutrient removal.

b. Compliance with Water Quality Criteria..continued..

Thermal pollution has not constituted a problem but may grow important with growing power production and a trend to very large plants.

Supplemental irrigation is very limited and return flows create no solids buildup problem.

c. Construction Schedules

Table 11 indicates the time schedule for the municipality or industry that has been established by the Water Pollution Control Commission to bring about compliance with the standards. Contract award dates have been given for projects where the Commission has given an order to proceed with pollution abatement. Project completion dates have not been set by the Commission due to the great variability and uncertainty of construction projects. Projects listed with the July 1, 1972 date will be expected to have construction underway by that date. More specific and earlier time schedules will be established by the Commission in most instances. If it appears that there will not be compliance with the construction time schedules, the Commission will hold a hearing and issue orders setting up the construction schedule.

As time progresses, additional schedules will be set according to the available data on stream quality surveys and monitoring which will be expanded to cover all the streams of the state where pollution can occur.

A project completion schedule typical of those which have been negotiated or ordered by the Water Pollution Control Commission is as follows:

Orders for pollution abatement
Preliminary report due in 6 months
Final design due in 6 months
Contract award due in 4 months
Construction completed in 6-24 months

Since nearly all present and future municipal treatment plant construction will be partially financed by Federal grant funds, certain time allowances have been incorporated to allow for Federal processing of grant applications and a review of design plans and specifications.

c. Construction Schedules..continued...

Ample Federal Water Pollution Control Administration construction grant funds will be available for all projects on a "first come-first served" basis if Congressional appropriations are made at authorized levels.

2. COMBINED SEWER OVERFLOWS

It has been the policy of the State Department of Health since 1930 not to approve combined sewer systems and has recommended a program of complete separation of sanitary and storm sewers. Under the Iowa Water Pollution Law, the overflow from the combined sewers is pollution and the Water Pollution Control Commission has taken the position of recommending the separation of the systems. It is recognized that separation is a long and costly project since the combined systems are located in the older and larger cities where development has increased their replacement costs. A majority of the cities have accepted recommendations to initiate a sewer separation program on a schedule spaced over a period of time.

3. AGRICULTURAL WASTEWATERS

Agricultural pollution in the State of Iowa occurs basically in three forms:

1. Turbidity from soil erosion
2. Toxicity from agricultural chemicals
3. Wastes from feedlots

The Commission has appointed an Agricultural Advisory Committee comprised of faculty members from two of the State Universities to assist the Commission in matters relating to agricultural wastes. This committee is subject to call by the Commission to study specific agricultural problems and to make recommendations for corrective action. The lack of practicable methods for corrective action precludes the setting of a timetable without further research and technology.

Soil Erosion

Currently there is no legislation requiring farmland owners and operators to practice soil and water conservation measures which control farmland runoff. Soil

Soil Erosion...continued...

erosion and consequent turbidity in the receiving streams is an increasing problem throughout the State of Iowa. Several factors contribute to the problem of erosion. Agriculturalists expect at least 18 million acres of corn and soybeans will be grown in Iowa by 1970, an increase of 4 million acres over 1964. To get this increased acreage, farmers on rolling farm land are farming their steeper land much more instensively to row crops than in the past and erosion is accelerated greatly. Less pasture and hay land is needed as dairying decreases in Iowa, therefore, much of the land formerly in rotation meadow and pasture is now in row crops. This reduces the use of strip cropping tremendously. As farms get larger, farmers are reluctant to use any conservation practices that slow down planting and caring for row crops. Thus the use of contouring, older style terracing and waterways have been difficult to maintain and expand.

The State Soil Conservation Committee is carrying on an active program through its Soil Conservation Districts to assist landowners and operators in developing soil conservation plans. Currently over 60,000 farmers have developed soil conservation plans for over 12,500,000 farmland acres using the advice and aid of the Soil Conservation District offices.

The Soil Conservation Service of the U.S. Department of Agriculture is active in planning and financing watershed programs under Public Law 566 to reduce soil erosion. Currently 635,000 acres of watershed have been developed or are under construction and an additional 800,000 acres are in the planning stages.

Marked results in soil loss reduction have been effected on lands under soil management programs; however, these programs cover less than half the farmland acreage. In addition, changing farming practices and the trend toward larger farms and machinery as described previously tend to increase the erosion problem.

The Water Pollution Control Commission endorses the action of the State Soil Conservation Committee, the Soil Conservation Service and others, and plans to continue to work with them to further reduce agricultural wastes resulting from erosion.

Agricultural Chemicals

With the increasing demand for higher yields, farmers are increasing the amount of herbicides, pesticides and fertilizer applications to their lands. Invariably, considerable amounts of these chemicals find their way to the waters of the state. In sufficient concentration many of these chemicals can exert a toxic effect upon the aquatic life present in the receiving water. Fertilizers of nitrate and phosphate base supply nutrients which can support undesirable algal populations capable of producing taste and odors or possible toxic wastes. The control of these wastes must be in the application methods and the prevention of farmland runoff.

The state has been monitoring the surface waters since 1965 for chlorinated hydrocarbon pesticide levels. Plans are being made for the expansion of the monitoring program.

Feedlot Wastes

An increasing potential source of stream pollution is the waste from sizeable farm feedlots. Currently there are 100 farms feeding over 1,000 head of cattle, 10 farms feeding over 2,500 hogs and 2 farms raising over 50,000 chickens. Although there are few records available regarding feedlot waste problems in the state, a few individual cases indicate that some problems of pollution do exist. The increasing concentration of livestock on fewer farms and the resulting larger operations will present additional waste disposal problems.

A study committee comprised of three Commission members, two agricultural engineers and a veterinarian from Iowa State University was formed in November of 1966 to study the feedlot waste problem and recommend corrective measures toward waste control. The committee advised the Commission that:

1. Feedlots can be a source of considerable stream pollution when improperly designed.
2. A permit system for large operations may be a control measure.
3. Education of the feedlot owners may produce effective results to control feedlot runoff.
4. The control of feedlot wastes could be instigated through Rules and Regulations of the Commission.

Feedlot Wastes...continued....

As additional information and experience becomes available providing an effective means of controlling feedlot wastes, the Commission will consider and adopt those measures which are best suited to control the pollution problem.

4. WASTE FROM BOATS AND MARINAS

Wastes from marinas and boats in the opinion of the Water Pollution Control Commission and the State Conservation Commission do not currently present a serious pollutional problem to the state waters. Representatives of the State Conservation Commission and State Department of Health attended a joint meeting with western bordering states, concerning marina and boat wastes, to discuss methods for the prevention of pollution from these sources.

It is the plan of the Water Pollution Control Commission and the State Conservation Commission to initiate legislation in the next General Assembly that would control marina and boat wastes. It is anticipated that the legislation will require holding tanks which store wastes from marine toilets for subsequent shore disposal. Sufficient time will be incorporated in the legislation to allow existing facilities to comply with the requirements.

SECTION IV
PUBLIC HEARINGS

The Iowa Surface Water Quality Criteria are designed to protect the waters of the state for those present and future uses which are most beneficial to the people. To accomplish this goal, the Iowa Water Pollution Control Commission developed tentative standards and presented these to the public at seven public hearings throughout the state.

The procedures which the Commission followed to conduct the public hearings are outlined and discussed below:

1. Hearing Notice

The Commission distributed 6500 hearing notices to all parties interested and affected by the criteria. Those **main** groups which received hearing notices were: Agriculture, Conservation, Government, Industry, and Municipalities. The distribution list is shown in Appendix A-1. The hearing notice contained the following information:

a. Hearing locations, times, etc.
b. Explanation of hearing
c. Streams and water sheds pertaining to each hearing location(map)
d. Tentative criteria

A copy of the hearing notice is presented in Appendix A-2.

2. Hearing Advertisement

The Commission advertised the hearing times and locations in the newspapers of the seven municipalities where the hearings were scheduled in three publications at weekly intervals. The newspapers and publication dates and copies of the advertisement of the hearings are shown in Appendix A-3 and 4 respectively.

3. Hearing Proceedings

At the opening of each hearing a Commission member acting as chairman read the opening statement which is presented in Appendix A-5. The statement presented the history of the proposed criteria, application of the criteria, purpose of the public hearing and the means by which the criteria will be enforced.

3. Hearing Proceedings...continued...

All seven public hearings were well attended by a broad representation of the public interested and affected by the proposed criteria. A listing of all those attending and those who presented oral or written statements is shown in Appendix A-6. Attendance averaged over 100 persons per hearing.

4. Statements

Oral and written statements presented at each hearing expressed the interests of all major groups, organizations and individuals. Tape recordings were made at all hearing locations and a summary of statements presented was compiled and is presented in Appendix A-7.

Upon completion of the seven hearings the Commission reviewed the opinions expressed towards all aspects of the proposed criteria. It was felt that much was gained towards knowledge of public opinion concerning the criteria and changes that were proposed.

A majority of statements presented were in total agreement with the proposed criteria. The remaining statements were again in agreement with the criteria with some exceptions regarding parameters, water uses or classifications.

Upon review of the hearing record and data available the Commission revised the proposed criteria and adopted them as the Iowa Surface Water Criteria on February 28, 1967.

*Appendices A-1 through A-7 referred to in Section IV have been omitted from this copy.

TABLE 1
MAGNITUDE & FREQUENCY OF ANNUAL LOW FLOW
10 YEAR RECURRENCE INTERVALS

Stream-gaging Station	Drainage Area (Square miles)	10 year Low Flow cfs per sq. mile of Drainage Area 1 day	7 day	30 day
Upper Iowa River near Decorah	568	0.055	0.064	0.075
Yellow River at Ion	221	.068	.078	.088
Turkey River at Garber	1,545	.035	.042	.052
Little Maquoketa River near Durango	130	.050	.060	.070
Maquoketa River near Manchester	305	.059	.068	.080
Maquoketa River near Maquoketa	1,553	.064	.082	.102
Wapsipinicon River at Independence	1,048	--------	.011	.016
Wapsipinicon River near DeWitt	2,330	.027	.034	.043
Iowa River near Rowan	429	.0060	.0080	.011
Iowa River at Marshalltown	1,532	.0053	.0094	.015
Iowa River near Belle Plaine	2,455	.011	.015	.019
Rapid Creek near Iowa City	24.6	--------	.00027	.00053
Iowa River at Iowa City	3,271	.011	.015	.020
Ralston Creek at Iowa City	3.01	--------	--------	--------
English River at Kalona	573	.0015	.0023	.0036
Cedar River at Janesville	1,661	.038	.045	.052
Lime Creek at Mason City	526	.010	.013	.015
Shell Rock River at Marble Rock	1,318	.014	.018	.024
Cedar River at Waterloo	5,146	.046	.052	.059
Cedar River at Cedar Rapids	6,510	.039	.047	.056
Cedar River near Conesville	7,785	.052	.060	.068
Iowa River at Wapello	12,499	.035	.042	.050
Skunk River near Ames	315	.00020	.00027	.00036
Skunk River at Coppock	2,916	.0031	.0051	.0080
Skunk River at Augusta	4,303	.0018	.0032	.0056

TABLE 1 cont.

Stream-gaging Station	Drainage area (Square miles)	10 Year Low Flow cfs. per sq. mile of Drainage Area 1 day	7 day	30 day
West Fork Des Moines River at Jackson, Minn.	1,220	———	.000016	.00010
East Fork Des Moines River near Hardy	1,268	.0050	.0063	.0078
North Lizard Creek near Clare	257	.00039	.00063	.0011
Boone River near Webster City	844	.0027	.0037	.0050
Des Moines River near Boone	5,511	.0047	.0065	.086
North Raccoon River near Jefferson	1,619	0.0047	0.0064	0.0062
South Raccoon River at Redfield	988	.013	.016	.021
Raccoon River at Van Meter	3,441	.0037	.0056	.0082
North River near Norwalk	349	.000039	.000064	.00011
Middle River near Indianola	506	.0011	.0017	.0028
South River near Ackworth	474	.00058	.00092	.0015
Des Moines River near Tracy	12,479	.0052	.0075	.010
Des Moines River at Keosauqua	14,038	.0047	.0070	.010
Fox River at Cantril	161	.00025	.00043	.00084
Big Sioux River at Akron	8,851	.0010	.0018	.0027
Floyd River at James	882	.0018	.0031	.0050
Little Sioux River at Correctionville	2,500	.0055	.0073	.0092
Maple River at Mapleton	669	.0061	.0084	.011
West Fork Ditch at Holly Springs	399	.0025	.0035	.0048
Soldier River at Pisgah	407	.0022	.0039	.0060
Boyer River at Logan	871	.00087	.0017	.0035
East Nishnabotna River at Red Oak	894	.0058	.0086	.013
Nishnabotna River above Hamburg	2,806	.0027	.0045	.0074
Nodaway River at Clarinda	762	.0048	.0064	.0084
Thompson River at Davis City	701	.0010	.0017	.0026
Chariton River near Centerville	708	.000088	.00022	.00046

TABLE 2
Public Surface Water Supplies

Lake or Stream Supply

Municipality	Source	Consumption MGD	Treatment Provided		
Adel	Raccoon River	0.2 mgd	F	S	D
Arnolds Park	W. Okoboji Lake	0.2			"
Bedford	*102 River	0.15	"		"
Burlington	*Mississippi River	5.0	"	"	"
Cedar Rapids	*Cedar River	Standby	"	"	"
Clarinda	*Nodaway River	0.5	"		"
Clear Lake	Clear Lake	0.5	"		"
Council Bluffs	*Missouri River	6.0	"	"	"
Davenport	*Mississippi River	14.0	"		"
Des Moines	Raccoon River	30.0	"	"	"
Fort Madison	*Mississippi River	1.2	"		"
Glenwood	Keg Creek	0.1	"	"	"
Iowa City	Iowa River	4.0	"	"	"
Keokuk	*Mississippi River	3.0	"	"	"
Lake Park	Silver Lake	0.1	"	"	"
Milford	W. Okoboji Lake	0.15			"
Okoboji	W. Okoboji Lake	0.1			"
Ottumwa	*Des Moines River	5.0	"	"	"
Panora	Raccoon River	0.1	"	"	"
Spirit Lake	Spirit Lake	0.5	"	"	"

* Denotes Interstate Stream

F - Filtration S - Softening D - Disinfection

Impoundments

Afton
Albia
Allerton
Bloomfield
Centerville
Chariton
Corning
Corydon
Creston
Fairfield
Greenfield
Humeston
Lamoni
Lenox
Montezuma
Mount Ayr
Osceola
Seymour
Tabor

TABLE 3
AQUATIC LIFE - WARM WATER AREAS

Streams	Reach of Stream
Missouri River Basin	
* Chariton River	Missouri State Line to Bridge on Highway #65
* Thompson River	Missouri State Line to Union County Line
* Nodaway River	Missouri State Line to confluence of East and West Nodaway
E. Nodaway River	Nodaway to Highway #148
W. Nodaway River	Nodaway to Morton Hills
Mid. Nodaway River	Nodaway to Adair County Line
* Nishnabotna River	Missouri State Line to confluence of East and West Nishnabotna
E. Nishnabotna River	Nishnabotna to Atlantic
W. Nishnabotna River	Nishnabotna to Avoca
* Missouri River	Western Iowa border from Missouri State Line to Sioux City
Boyer River	Missouri River to Denison
* Little Sioux River	Missouri River to Milford
*Ocheyedan River	Little Sioux River to Highway #9
W. Fk. Little Sioux	Little Sioux River to Climbing Hill
Maple River	Little Sioux River to Ida Grove
* Big Sioux River	Missouri River to Minnesota State Line
*Rock River	Big Sioux River to Minnesota State Line
Mississippi River Basin	
* Des Moines River	Mississippi River to confluence of East and West Forks of Des Moines River
*E. Fk. Des Moines River	Des Moines River to Burt
*W. Fk. Des Moines River	Des Moines River to Minnesota State Line
Middle River	Des Moines River to Town of Middle River
Raccoon River	Des Moines River to confluence of North and South Raccoon
S. Raccoon River	Raccoon River to Guthrie Center
N. Raccoon River	Raccoon River to Buena Vista County Line
M. Raccoon River	Raccoon River to Coon Rapids
Boone River	Des Moines River to Goldfield
Skunk River	Mississippi River to confluence of North and South Skunk
N. Skunk River	Skunk River to Highway #92
S. Skunk River	Skunk River to Colfax

TABLE 3 CONTINUED

*Mississippi River	Eastern Iowa border from Missouri State Line to Minnesota State Line
Iowa River	Mississippi River to Belmond
*Cedar River	Iowa River to Minnesota State Line
W. Fk. Cedar River	Cedar River to Cerro Gordo County Line
*Shell Rock River	Cedar River to Minnesota State Line
*Winnebago River	Shell Rock River to Minnesota State Line
*Little Cedar	Cedar River to Minnesota State Line
English River	Iowa River to Kinross
*Wapsinicon River	Mississippi River to Minnesota State Line
Buffalo Creek	Wapsipinicon River to Stanley
Little Wapsipinicon River	Wapsipinicon River to Sumner
Maquoketa River	Mississippi River to Backbone State Park
N. Fk. Maquoketa River	Maquoketa River to Dyersville
Turkey River	Mississippi River to Vernon Springs
Little Turkey River	Turkey River to Highway #24
Crane Creek	Little Turkey River to Saratoga
Volga River	Turkey River to Maynard
Yellow River	Mississippi River to Highway #51
*Upper Iowa River	Mississippi River to Chester

* Denotes Interstate Stream

TABLE 4

NATURAL LAKES

County	Lakes	Acres	Lakes	Acres
Allamakee	Kains Lake	200	Mud	164
	Lansing Big	679	New Albin Big	200
Buena Vista	Storm Lake	3,060	Pickeral (Clay Co.)	176
Calhoun	North Twin	569	South Twin	600
Cerro Gordo	Clear	3,643		
Clay	Dan Greene Slough	285	Round	450
	Elk	261	Trumbull	1,190
Delaware	Silver	45		
Dickinson	Center	264	Marble	175
	Diamond	166	Pleasant	82
	East Okoboji	1,875	Prairie	136
	Lower Gar	---	Silver	1,068
	Upper Gar	---	Spirit	5,684
	Minnewashta	---	Swan	371
	Hottes	312	Welch	75
	Jemmerson Slough	100	West Okoboji	3,939
	Little Spirit	214		
Emmet	Cheevers	341	Ingham	421
	Four Mile	219	Tuttle	981
	High	467	Twelve Mile	290
	Iowa	308	West Swan	1,038
Hamilton	Little Wall	273		
Hancock	Crystal	283	East Twin	193
	Eagle	906	West Twin	109
Harrison	Nobles (Pott. Co.)	160		
Johnson	Babcocks	58	Swan	44
Kossuth	Goose	103	Swag	46
Lee	Green Bay	272		
Louisa	Wapello (Klum)	212		
Monona	Blue	918		
Muscatine	Keokuk	511	Muscatine Slough	237
Osceola	Rush	359	Iowa	116
Palo Alto	Five Island (Medium)	945	Silver	638
	Lost Island	1,260	Virgin	200
	Rush	460		
Pocahontas	Clear	187	Lizzard	268
Pottawattamie	Manawa	660		
Sac	Black Hawk (Wall)	957		
Winnebago	Duck (Harmon)	72	Rice (Worth Co.)	612
Woodbury	Browns	840		
Worth	Brights	122	Silver	318
Wright	Cornelia	385	Elm	463

TABLE 5
Artificial Lakes

County	Lake	Acres
Adair	Meadow Lake	42
Carroll	Swan Lake	130
Cass	Cold Springs	16
Davis	Lake Wapello	287
Decatur	Nine Eagles	56
Des Moines and Henry	Geode	205
Franklin	Beeds Lake	130
Greene	Spring Lake	49
Guthrie	Springbrook	27
Hancock	Pilot Knob	15
Hardin	Pine Lake	63
Hardin	Upper Pine Lake	101
Jasper	Rock Creek Lake	640
Johnson	Lake MacBride	950
Lucas	Red Haw Hill	72
Mahaska	Lake Keomah	82
Monroe	Miami	143
Montgomery	Viking Lake	150
O'Brien	Mill Creek	25
Shelby	Prairie Rose	218
Tama	Union Grove	110
*Taylor	Lake of Three Fires	125
Union	Green Valley Lake	390
Van Buren	Lacey-Keosauqua	30
Warren	Lake Ahquabi	130
Washington	Lake Darling	302
Wayne	Allerton	115

* On lakes of over 100 acres no motor in excess of 6 H.P. allowed.

TABLE 6
AQUATIC LIFE USE - COLD WATER AREAS

COUNTY	STREAM	MILES
ALLAMAKEE		
	Bear Creek	1
	Clear Creek	1
	French Creek	4
	Hickory Creek	4
	Little Paint Creek	2.5
	Livingood Springs and Yellow River Confluence area	1
	Paint Creek	7
	Teeple Creek	2.5
	Village Creek	6
	Waterloo Creek	6.5
	Wexford Creek	1.5
CLAYTON		
	Bloody Run Creek	9
	Buck Creek	6
	Ensign Hollow	2
	Joy Springs & Maquoketa Riv.	2
	Klienlein Creek	3
	North Cedar Creek	2
	Plum Creek	1.5
	South Cedar Creek	3
	Turkey River Adjacent to Big Springs Hatchery	.75
DELAWARE		
	Elk Creek	1
	Maquoketa River	2
	Richmond Springs	1
	Spring Branch	2
	Turkey Creek	1
DUBUQUE		
	Plum Creek	.5
	Swiss Valley Creek	1.5
FAYETTE		
	Glovers Creek	1
	Grannis Creek	1
	Mink Creek	2
	Otter Creek	4
HOWARD		
	Bigalk Creek	1.5

Table 6 cont.

COUNTY	STREAM	MILES
JACKSON		
	Big Mill Creek	5
	Brush Creek	4
	Dalton Lake	1.5 acres
	Little Mill Creek	5
MITCHELL		
	Spring Creek	2
	Turtle Creek	2
	Wapsie River	2.5
WINNESHIEK		
	Bohemian Creek	3
	Coldwater Creek	2.5
	North Bear Creek	5
	South Bear Creek	5
	Trout River	2.5
	Trout Run	2
	Twin Springs	0.5
	West Canoe Creek	4

TABLE 7
DESIGNATED RECREATION AREAS ON IOWA STREAMS

River or Stream Areas

	NEAREST TOWN	STREAM	RECREATION ZONE
1.	Minnesota-Missouri	Mississippi River	Iowa Border
2.	Alden	Iowa River	Above Dam
3.	Anamosa	Wapsipinicon River	Above Dam
4.	Bonaparte	Des Moines River	Above Dam
5.	Cedar Falls	Cedar River	Above Dam
6.	Cedar Rapids	Cedar River	Above Dam
7.	Central City	Wapsipinicon River	Above Dam
8.	Charles City	Cedar River	Above Dam
9.	Clarksville	Shell Rock River	Above Dam
10.	Coralville Reservoir	Iowa River	Recreation Pool
11.	Decorah	Upper Iowa River	Above Dam
12.	Delhi	Maquoketa River	Above Dam
13.	Des Moines	Des Moines River	Above Dam
14.	Elkader	Turkey River	Above Dam
15.	Fort Dodge	Des Moines River	Above Dam
16.	Greene	Shell Rock River	Above Dam
17.	Hopkinton	Maquoketa River	Above Dam
18.	Humboldt	Des Moines River	Above Dam
19.	Independence	Wapsipinicon River	Above Dam
20.	Iowa City	Iowa River	Above Dam
21.	Iowa Falls	Iowa River	Above Dam
22.	Lime Springs	Upper Iowa River	Above Dam
23	Manchester	Maquoketa River	Above Dam
24.	Maquoketa	Maquoketa River	Above Dam
25.	Mitchell	Cedar River	Above Dam
26.	Monticello	Maquoketa River	Above Dam
27.	Nashua	Cedar River	Above Dam
28.	Oakland Mills	Skunk River	Above Dam
29.	Ottumwa	Des Moines River	Above Dam
30.	Palisade State Park	Cedar River	Above Dam
31.	Quasqueton	Wapsipinicon River	Above Dam
32.	Red Rock Reservoir	Des Moines River	Recreation Pool (Under construction)
33.	Saylorville Reservoir	Des Moines River	Recreation Pool (Under construction)
34.	Steamboat Rock	Iowa River	Above Dam
35.	Waterloo	Cedar River	Above Dam
36.	Waverly	Cedar River	Above Dam

707

Table 7 cont.

NATURAL AND ARTIFICIAL LAKES

All natural and artificial lakes listed in TABLES 4 and 5 Aquatic Life - Warm Water Areas shall be also classified for Recreational Use.

FUTURE POTENTIAL RESERVOIRS FOR RECREATIONAL USE:

When the following reservoirs are built their impounded waters will be classified for Recreational Use.

NAME	STREAM	STATUS
Ames Reservoir	Skunk River	Authorized
Central City Reservoir	Wapsipinicon	Authorized
Davids Creek Reservoir	Davids Creek	Needs Authorization
Jefferson Reservoir	Raccoon River	Study Conducted
Rathbun Reservoir	Chariton River	Authorized
Rochester Reservoir	Cedar River	Authorized
Squaw Creek Reservoir	Squaw Creek	Planning Stage

TABLE 8

SURFACE WATER SAMPLING STATIONS ABS, PESTICIDES AND RADIOACTIVITY

ABS	STREAMS	LOCATION
	Cedar River	Cedar Rapids
	Des Moines River	Des Moines upstream
	Des Moines River	Des Moines downstream
	Iowa River	Iowa City
	Raccoon River	Des Moines (IPALCO)
PESTICIDES	Cedar River	Cedar Rapids
	Iowa River	Iowa City
	Mississippi River	Dubuque
	Mississippi River	Davenport
	Missouri River	Council Bluffs
	Raccoon River	Des Moines
RADIOACTIVITY	Big Sioux River	Hawarden
	Cedar River	Osage
		Cedar Rapids
	Des Moines River	Des Moines upstream
		Des Moines downstream
		Estherville
		Ottumwa
	Iowa River	Iowa City
	Mississippi River	Lansing
		Dubuque
		Davenport
		Ft. Madison
	Missouri River	Sioux City
		Council Bluffs
	Raccoon River	Des Moines
	Skunk River	Ames
	Lakes	
	Clear Lake	
	Okoboji	
	Impoundments	
	Corning	
	Fairfield	
	Greenfield	

TABLE 9

SURFACE WATER SAMPLING STATIONS
PUBLIC WATER SUPPLIES AND MAJOR CITIES

Stream	Location	
Big Sioux River	Hawarden	A, B
	Sioux City	A*
Cedar River	St. Ansgar	A
	Charles City	A, B
	Waterloo	A, B
	Cedar Rapids	A*, B
	Columbus Jct.	A, B
Chariton River	Chariton	B
	Centerville	A, B
Des Moines River	Fort Dodge	A*, B
	Des Moines	A*, B
	Ottumwa	A*, B
	Keokuk	A
East Fork Des Moines River	Dolliver	A
	Dakota City	A
Fox River	Bloomfield	A, B
Little Sioux	Spencer	A, B
	Cherokee	A, B
	Jct. with Mo.	A
Mid. Fork Medicine Creek	Allerton	B
Mississippi River	Dubuque	A*, B
	Clinton	A*, B
	Davenport	A*, B
	Burlington	A*, B
	Fort Madison	A*, B
	Keokuk	A*, B
Missouri River	Sioux City	A*, B
	Council Bluffs	A*, B
Nishnabotna River	Hamburg	A, B
Nodaway River	Clarinda	A*, B
102 River	Bedford	A*, B
Rock River	Rock Rapids	A, B
	Jct. with Big Sioux	A

TABLE 9 CONTINUED

710

Stream	Location	
Shell Rock River	Northwood	A
Upper Iowa River	Decorah	A, B
	New Albin	B
Wapsipinicon River	Independence	A, B
	Anamosa	A, B
	Jct. with Mississippi	A
West Fork Des Moines River	Estherville	A, B
	Emmetsburg	A, B
	Humboldt	A
Winnebago River	Lake Mills	A
	Mason City	A, B

A - Location above water supply inlet or waste outlet
B - Location below waste outlet after adequate mixing
* - Locations presently sampled

TABLE 10
CHEMICAL QUALITY OF IOWA STREAMS

River	Location	Total Solids mg/l	pH	Cl mg/l	Ammonia NH_3 mg/l	Nitrate NO_3 mg/l	Total Susp. S mg/l	Total PO_4 mg/l	COD mg/l
Big Sioux	Sioux City	460-990	7.6-8.4	8-80	0.0-4.9	0.1-1.1	10-430	0.7-4.8	30-70
Cedar	Cedar Rapids	300-730	8.0-8.5	8-30	0.0-1.1	0.2-3.8	20-420	1.1-2.0	20-60
Des Moines	Ottumwa	460-3000	7.8-8.4	6-40	0.0-9.5	0.2-4.0	20-2500	0.8-4.6	20-180
	Des Moines	540-860	7.8-8.2	5-40	0.0-0.7	1.2-4.8	10-540	0.8-1.8	10-60
	Fort Dodge	450-1100	7.6-8.1	5-40	0.0-0.9	1.2-4.0	10-790	0.5-3.3	10-120
Iowa	Iowa City	370-530	7.6-7.9	3-20	0.0-1.4	0.2-2.9	10-380	0.1-2.0	10-60
	Marshalltown	390-870	7.7-8.2	6-20	0.0-0.3	0.1-6.3	10-490	0.6-2.2	10-70
Mississippi	Keokuk	230-400	7.7-8.1	4-10	0.2-0.7	0.5-1.8	10-220	0.3-1.4	20-40
	Ft. Madison	260-830	7.7-8.1	3-10	0.1-1.1	0.3-2.1	10-650	0.3-2.4	30-60
	Burlington	230-370	7.6-8.2	3-10	0.0-0.6	0.2-1.4	20-180	0.4-1.2	20-40
	Davenport	220-370	7.5-8.2	5-10	0.0-0.9	0.2-1.5	10-200	0.3-1.4	20-50
	Clinton	200-300	7.5-8.2	2-10	0.0-0.6	0.2-1.0	10-100	0.3-1.0	20-40
	Dubuque	250-300	7.6-8.0	4-10	0.0-0.6	0.3-0.6	10-100	0.3-1.1	20-30
Missouri	Council Bluffs	600-3000	7.9-8.2	3-20	0.0-1.0	0.3-1.1	30-2600	0.1-8.0	20-150
	Sioux City	530-2000	7.9-8.3	9-20	0.0-0.6	0.1-0.6	20-560	0.3-4.4	10-40
Nodaway	Clarinda	240-4000	7.4-8.1	2-10	0.0-0.3	0.2-2.1	10-3800	0.2-6.5	10-130
Raccoon	Des Moines	370-1500	7.8-8.3	6-20	0.0-0.2	0.8-5.5	10-1150	0.3-2.1	10-110
	Adel	350-2600	7.5-8.4	3-30	0.0-0.5	0.4-5.4	20-2400	0.4-3.1	10-220
Mid. Raccoon	Panora	430-6350	7.3-8.3	1-10	0.0-0.8	0.4-4.9	10-6000	0.5-6.6	10-360
Skunk	Oskaloosa	360-640	7.7-8.4	8-20	0.0-0.7	0.2-4.5	20-430	0.6-1.4	10-30
	Ames	500-750	7.8-8.1	7-40	0.0-1.3	1.9-8.5	10-350	[illegible]	10-50

TABLE 11

WATER POLLUTION CONTROL NEEDS AND DESIGNATED WATER USES
(Revised June 1, 1968)

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT (1)	TREATMENT NEEDS	COMPLIANCE SCHEDULE (2)	WATER USE
MISSISSIPPI RIVER BASIN						
*Mississippi River Main Stem	Keokuk	16316	PC	Coliform red.	July 1, 1970	1,2,3
	Hubinger Company		WC			2,3
	Montrose	632	ST	Coliform red.	July 1, 1970	2,3
	Chevron Chemical		WC			2,3
	Crandon Mill		WC	Additions	July 1, 1972	2,3
	Fort Madison	15247	PC	Coliform red.	July 1, 1970	1,2,3
	Sinclair Fertilizer		WC	Construction		2,3
	Burlington	33285	PC	Coliform red.	July 1, 1970	1,2,3
	Monsanto Chemical		WC			2,3
	Muscatine	20997	PC	Coliform red.	July 1, 1970	2,3
	Buffalo	1088	IT-C			2,3
	Davenport	88981	PC	Expansion and Coliform red.	July 1, 1972	1,2,3
	Bettendorf	17264	Davenport			2,3
	Aluminum Company		PC-TF-C			2,3
	-Industrial		Chemical			2,3
	LeClaire	1546	IT	Coliform red.	July 1, 1970	2,3
	Princeton	580	L			2,3
	Hawkeye Chemical		WC			2,3
	Camanche	3055	IT	Coliform red.	July 1, 1970	2,3
	Dupont cellophane		WC	Additions	July 1, 1972	2,3

(1) TREATMENT FACILITIES KEY

Imhoff Type	IT	Sand Filter	SF
Septic Tank	ST	Activated Sludge	AS
Primary Clarifier	PC	Extended Aeration	AE
Lagoon	L	Waste Control	WC
Trickling Filter	TF	Chlorination	C

(2) CONTRACT AWARD DATE

* Interstate Streams

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
	Clinton	33589	PC	Coliform red.	July 1, 1970	2,3
	Clinton Corn Proc.		WC	Additions	July 1, 1972	2,3
	Sabula	894	IT-C			2,3
	Bellevue	2181	IT	Coliform red.	July 1, 1970	2,3
	Dubuque	56606	PC	Coliform red.	July 1, 1970	2,3
	Guttenburg	2087	IT	Coliform red.	July 1, 1970	2,3
	McGregor	1040	IT	Coliform red.	July 1, 1970	2,3
	Marquette	572	None	New Plant	July 1, 1969	2,3
	Lansing	1325	None	New Plant	July 1, 1969	2,3
	New Albin	643	L	Additions	July 1, 1969	2,3
North Fabius	Moulton	773	IT-TF	Replacement	July 1, 1969	4
*Fox River	Bloomfield	2771	PC-TF			4
*Des Moines River	Keosauqua	1023	L			2
	Eldon	1386	None	New Plant	July 1, 1968	2
	Ottumwa	33871	PC	Additions	July 1, 1972	1,2,3
	Morrell & Co.		None	New Plant	July 1, 1968	
	Eddyville	1014	L			
	Pleasant Hill	1025	L	Replacement	July 1, 1968	2
	Des Moines	208982	PC-TF(2)	Awarded		2,3
	Lehigh	846	L			2
	Otho	593	L			2
	Fort Dodge	29654	PC-TF(2)			2,3
Sugar Creek	Donnellson	709	IT-TF			4
Lick Creek	Birmingham	441	L			4
Miller Creek	Albia-N	4582	PC-TF			4
Muchakinock Creek	Beacon	718	L			4
	Oskaloosa-S	11053	PC-TF	Expansion	July 1, 1972	4
	-SE		L			

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
Cedar Creek	Bussey	557	None	New Plant	July 1, 1969	4
	Lovilia	630	Lo			
	Albia-SW		IT-TF			4
Creek	Pella-SW	5198	IT-TF			4
White Breast Creek	Knoxville Vet. Adm.		PC-TF			4
	Lacona	396	L			4
	Osceola	3350	PC-TF			
Competine Creek	Knoxville	8493	PC-TF			4
Kirk Creek	Melcher	867	ST-SF	Replacement	July 1, 1968	4
Brush Creek	Monroe (SW)	867	L			4
Calhoun Creek	Prairie City	943	IT-TF			4
Dry Run	Pleasantville	1025	L			4
South River						4
Squaw Creek	New Virginia SD	381	L			4
Ditch	Indianola (S)	7062	Ac			
Otter Creek	Milo	468	L			4
Camp Creek	Mitchellville	1107	IT-TF			4
Mud Creek	Bondurant	389	L			4
Middle River	Winterset	3639	PC-TF	Expansion	July 1, 1969	2
	Martensdale	316	L			2
Deer Creek	Indianola	7062	PC-TF	Expansion	July 1, 1968	4
S Fk Middle River	Adair	742	IT-TF			4
North River	Carlisle	1930	L			4
	Norwalk	1630	L			4
Middle Creek	Highland Hills-DM Plt		PC-TF			4
N Br North River	Dexter	670	ST-SF	Replacement	July 1, 1972	4
	Earlham	788	L			4
Four Mile Creek	Ankeny-East	5910	PC-TF	Expansion	July 1, 1972	4
	Slater	979	TF-L			4
E Four Mile Creek	Altoona	2424	IT-TF	Expansion and	July 1, 1968	4
				Coliform red		2
Raccoon River (Des Moines R.)	West Des Moines	13720	(Des Moines)			1,2
	Van Meter	465	L			2
	Windsor Heights	6409	(Des Moines)			4

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
Walnut Creek	Urbandale-Benton	5821	IT-TF	Abandon	July 1, 1968	4
	Clive	1735	(Des Moines)			4
	Dallas Center	1083	IT-TF	Expansion	July 1, 1972	4
Sugar Creek	Waukee	1267	L	Expansion	July 1, 1969	4
Middle Raccoon	Redfield	966	L			2
	Panora	1019	None	New Plant	July 1, 1969	2
	Coon Rapids	1560	PC-TF			2
	Carroll	8481	PC-TF			4
Bear Creek	Earlham	788	IT-TF	Replacement	July 1, 1969	4
South Raccoon	Guthrie Center	2071	PC-TF(2)			2
Dry Run	Stuart	1481	IT-TF			4
Mosquito Creek	Bagley	406	ST	Replacement	July 1, 1969	4
Willow Creek	Glidden	993	IT-TF			4
North Raccoon	Adel	2295	PC-TF			2
	Perry	6442	PC-TF			2
	Oscar Mayer Co.		LL			2
	Jefferson	4570	PC-TF			2
	Sac City	3354	PC-TF			2
Dry Run	Minburn	357	L			4
Snake Creek	Rippey	331	None	New Plant	July 1, 1968	4
East Buttrick Creek	Grand Junction	949	IT-TF	Expansion	July 1, 1972	4
West Buttrick Creek	Gowrie	1129	IT-TF			4
Hardin Creek	Churdan	586	L			4
Dry Run	Scranton	865	IT-TF	Expansion	July 1, 1972	4
Cedar Creek	Lohrville	653	IT-TF			4
	Manson	1789	L			4
Lake Creek	Lake City-North	2114	PC-TF			4
	-West		IT-TF			4
	Rockwell City	2313	PC-TF			4
	Womens Reformatory		Lo			4
	Pomeroy	816	L			4

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
W Fk Camp Creek	Lytton & Industry	376	PC-TF	Expansion	July 1, 1969	4
Indian Creek	Lake View	1165	IT-TF			4
	Breda	543	IT-SF			4
Cedar Creek	Fonda	1026	IT-TF			4
	Laurens	1799	ST-TF			4
	Newell	893	IT-TF			4
Boyer Creek	Lakeside	306	None	New Plant	July 1, 1968	4
	Storm Lake	7728	PC-TF(2)			4
	Hygrade Food		L-L			4
Ditch	Albert City	722	IT-TF			4
Saylor Creek	Ankeny-West		PC-TF	Coliform red.	July 1, 1970	4
Beaver Creek	Urbandale-Beaver Ck Plt		PC-TF			4
	Granger	468	L	Expansion	July 1, 1969	4
	Grimes	697	PC-TF			4
	Beaver Valley Cannery		L	Expansion	July 1, 1968	4
Little Beaver Creek	Woodward	967	L			4
East Beaver Creek	Ogden	1525	PC-TF			4
Big Creek	Polk City	567	L			4
Creek	Madrid	2286	PC-TF			4
Creek	Woodward State Hospital		PC-TF			4
Honey Creek	Boone	12468	PC-TF			4
Skillet Creek	Dayton	820	IT-TF			4
Boone River	Webster City	8520	PC-TF(2)			2
	Goldfield	682	L			2
	Renwick	477	L			4
	Corwith	488	IT-SF	Replacement	July 1, 1972	4

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
Ditch	Stratford	703	AE			4
White Fox Creek	Clarion	3232	PC-TF	Expansion	July 1, 1972	4
Ditch	Eagle Grove	4381	PC-TF			4
Otter Creek	Kanawha	735	IT-SF	Replacement	July 1, 1972	4
Middle Branch	Britt	2042	PC-TF	Expansion	July 1, 1972	4
Brushy Creek	Duncombe	355	L			4
Lizard Creek	Pocahontas	2011	PC-TF			4
N Br Lizard Creek	Gilmore City	688	L			4
Badger Creek	Badger	340	L	Expansion	July 1, 1969	4
*E Fk Des Moines River	Dakota City	706	IT-TF			2
	Algona	5977	PC-TF			2
	Armstrong	958	L			4
Lotts Creek	Livermore	545	L			4
	Whittemore	741	PC-TF			4
Trulner Creek	Bode	430	L			4
Ditch	Burt	620	L			4
Buffalo Creek	Titonka	647	TF-L			4
Mud Creek	Bancroft	1000	IT-SF	Replacement	July 1, 1972	4
	Swea City	805				4
*W Fk Des Moines River	Humboldt	4497	IT-TF			2
	Emmetsburg	3887	PC-TF	Expansion	July 1, 1968	2
	Graettinger	879	L			2
	Estherville	7927	PC-TF(2)	Expansion	July 1, 1972	2
Pilot Creek	Rolfe	819	IT-SF	Replacement	July 1, 1969	4
Prairie Creek	West Bend	910	IT-TF			4
Devils Creek	West Point	758	IT-TF			4
Skunk River	Reasnor	224	L			2
Skunk River	Colfax	2331	IT-TF			2
	Ames	34826	PC-TF	Expansion	July 1, 1972	4

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
	Story City	1943	IT-TF	Replacement	July 1, 1972	4
	Ellsworth	493	L			4
	Williams	490	ST-SF	Replacement	July 1, 1972	4
Brush Creek	10P-Burlington		IT-TF			4
	10P-Industrial		Carbon	Additions	July 1, 1972	4
Long Creek	Danville	579	IT-TF			4
Mud Creek	New London	1694	PC-TF	Additions	July 1, 1969	4
Big Creek	Mount Pleasant	7339	PC-TF			4
Fish	Salem	442	L			4
Cedar Creek						
Crow Creek	Fairfield	11587	PC-TF			4
Ditch	Fremont	461	L			4
Walnut Creek						4
Burr Oak Creek	Brighton	724	IT-SF			4
Sugar	Wayland	597	L			4
Crooked Creek						4
E. Fk Crooked Creek	Winfield	862	ST-TF	Additions	July 1, 1972	4
W. Fk Crooked Creek	Washington	6037	PC-TF			4
Dutch Creek	Keota	1096	IT-TF			4
Ditch	Hedrick	762	L			
North Skunk River	Lynnville	411	L			4
	Kellogg	623	IT-TF			4
Bridge Creek	Sigourney-East	2387	IT-TF			4
Rock Creek	-West		IT-TF			4
Coal Creek	What Cheer	956	IT-TF	Replacement	July 1, 1969	4
Dry Creek	New Sharon	1063	PC-TF			4
Moon Creek	Montezuma	1416	L			4
Sugar Creek	Grinnell	7367	PC-TF			4
Creek	Sully	508	L			4
Rock	Gilman	491	L			4
Creek	Melbourne	517	IT-TF			4
Spring Creek	Oskaloosa-NE	11053	PC-TF	Expansion	July 1, 1972	4
	University Park	569	ST	Replacement	July 1, 1972	4
	Pella-Main	6087	PC-TF			4
	-NW		IT-TF			4
Buck Creek	Monroe	1366	IT-TF			4

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
Sewer Creek	Newton-South	15381	PC-TF			4
Cherry Creek	-NW		IT-TF			4
	-SW		IT-TF			4
	-W		L			4
	Lambs Grove	234	IT-TF	Replacement	July 1, 1972	4
Prairie Creek	Baxter	681	L			4
Indian Creek	Maxwell	773	IT-TF			4
EB Indian Creek	Colo	574	L			4
W Br Indian Creek	Nevada	4840	PC-TF			4
Creek	Elkhart	260	L			4
Ditch	Huxley	629	IT-TF			4
Squaw Creek	Stanhope	461	IT-TF	Replacement	July 1, 1972	4
Bear Creek	Roland	748	L			4
Drainage Ditch	Jewell	1113	L			4
Flint River	Middletown	245	IT-SF			4
Spring Creek	West Burlington	3015	IT-TF			4
Hawkeye	Mediapolis	1040	L			4
*Iowa River	Wapello	1745	L			2
	Columbus Jct.	1160	None	New Plant	July 1, 1968	2
	Hills	310	AE			2
	Iowa City	41602	PC-TF			2,3
	University Heights	1111	(Iowa City)			
	Marengo	2264	L			2
	Tama	2925	PC-TF			2
	Packaging Corp.		WC	Additions	July 1, 1968	2
	Marshalltown	22521	AS	Expansion	July 1, 1972	2

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
	Union	534	L			2
	Eldora	3225	PC-TF	Expansion	July 1, 1972	2
	Training School		PC-TF			2
	Steamboat Rock	426	L			2,3
	Iowa Falls	6322	PC-TF			2,3
	Alden	838	IT-TF	Expansion	July 1, 1972	2
	Dows	882	IT-TF			2
	Belmond	2506	PC-TF			2
Prairie Creek	Lone Tree	717	L			4
English River	Riverside	656	AE			2
Smith Creek	Wellman	1085	IT-TF			4
Mid Fk English	North English	1004	PC-TF			4
Old Man Creek	Williamsburg	1342	PC-TF			4
Clear Creek	Coralville	3390	(Iowa City)			4
	Oakdale Sanatorium		PC-TF	Abandon	July 1, 1970	4
	Tiffin	311	AE			4
	Oxford	633	IT-TF			4
Creek	Amana		L			4
Muddy Creek	North Liberty	334	IT-TF			4
Turkey Creek	Solon	604	IT-TF			4
Hoosier Creek	Ely	268	L			4
Creek	Homestead SD		L			4
Bear Creek	Victor	870	AE			4
Little Bear Creek	Brooklyn	1415	PC-TF	Expansion	July 1, 1972	4
	Malcolm	416	L			4
Salt Creek	Belle Plaine	2923	PC-TF			4
E Br Salt Creek	Dysart	1197	IT-TF			4
Deer Creek	Toledo	2850	IT-TF			4

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
	Garwin	546	ST-SF	Replacement	July 1, 1972	4
Creek	LeGrand	465	L			4
Timber Creek						4
Brush Creek	Gilman	491	L			4
N Timber Creek	State Center	1142	PC-TF(2)			4
Chicken Creek	Albion	589	L			4
Honey Creek	Radcliffe	615	L			4
Honey Creek	Hubbard	806	L			4
E Br Iowa River	Klemme	615	IT-TF			4
	Garner	2151	PC-TF	Additions	July 1, 1972	4
*Cedar River (Above Iowa River)	Cedar Rapids-Indian Ck	103545	PC-TF			2,3
	-Main		PC-TF(2)			1,2,3
	Penick & Ford		WC	Inplant Control	July 1, 1968	2
	Palo	387	IT-TF			2,3
	Vinton	4781	PC-TF			2
	Waterloo	71755	PC-TF(2)	Additions	July 1, 1969	2,3
	John Deere Co.		WC	Additions	July 1, 1969	2
	Cedar Falls	26162	PC-TF(2)	Coliform red.	July 1, 1970	2,3
	Clay Equipment Co.		WC			2,3
	Janesville	648	IT-TF			2
	Waverly	6822	PC-TF			2,3
	Plainfield	445	ST-Perc	Replacement	July 1, 1972	2
	Nashua	1737	IT-TF			2
	Charles City	10419	PC-TF			2,3
Wapsinonoc	West Liberty	2042	PC-TF			4
W Br Wapsinonoc	West Branch	1053	IT-TF			4
Sugar Creek						4
Mud Creek	Wilton	1750	PC-TF			4
	Durant	1266	PC-TF			4
	Walcott	664	L			4
Bennett Creek	Bennett	374	L			4

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
Crooked Creek	Tipton	2862	PC-TF			4
Rock Creek	Stanwood	598	IT-TF			4
Clear Creek	Mechanicsville	1107	IT-TF			4
Spring Creek	Mt. Vernon	2593	PC-TF	Expansion	July 1, 1969	4
	Lisbon	1227	AE			4
Big Creek	Springville	785	IT-TF			4
Indian Creek	Marion	15267	(Cedar Rapids)			4
Dry Creek	Hiawatha	1336	(Cedar Rapids)			4
Prairie Creek	Fairfax	528	L			4
	Norway	516	L			4
	Blairstown	583	L			4
	Keystone	522	IT-TF	Expansion	July 1, 1972	4
Creek	Van Horne	554	IT-TF			4
Dry Creek	Atkins	527	IT-TF			4
Opossum Creek						4
Little Bear Creek	Newhall	601	L			4
Blue Creek	Center Point	1236	PC-TF			4
Hinkle Creek	Garrison	424	L			4
Lime Creek	Brandon	322	IT-SF			4
Spring Creek	Jesup	1488	IT-TF	Expansion	July 1, 1972	4
Wolf Creek	LaPorte City	2117	PC-TF			4
	Traer	1623	PC-TF			4
	Gladbrook	949	L			4
	Conrad	799	PC-TF			4
Black Hawk Creek	Hudson	1423	PC-TF	Expansion	July 1, 1969	4
	Reinbeck	1621	IT-TF			4
	Grundy Center	2403	PC-TF			4

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
Black Hawk Creek	Dike	630	IT-TF			4
Beaver Creek	Parkersburg	1468	IT-TF			4
	Aplington	614	IT-TF			4
	Ackley	1731	PC-TF			4
South Beaver Creek						4
South Fork	Wellsburg	827	IT-TF			4
*Shell Rock River	Shell Rock	1112	PC-TF			2
	Clarksville	1328	ST	Replacement	July 1, 1969	2,3
	Greene	1427	IT-TF			2
	Nora Springs	1275	PC-TF			2
	Northwood	1768	IT-TF			2
West Fork Cedar						2
Feddke Creek	Allison	952	L			4
Spring Creek	Dumont	719	L			4
	Hampton	4501	PC-TF			4
Bailey Creek	Sheffield	1156	ST	Replacement	July 1, 1969	4
Beaver Dam Ck	Rockwell	772	PC-TF			4
	Clear Lake SD		PC-TF			4
	Clear Lake	6301				
	Ventura	510				
*Winnebago River	Mason City	30642	PC-TF			2
	Jacob E. Decker		PC-TF			2
	American Crystal		WC	Additions	July 1, 1969	2
	Forest City	2930	PC-TF			2
	Leland	209	L			2
Ditch	Lake Mills	1758	L	Expansion	July 1, 1972	4
Plymouth Creek	Manly	1425	IT-TF	Expansion	July 1, 1968	4

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
Quarter Section Run	Denver	4930	L			4
Little Cedar River	Stacyville	588	IT-TF			4
Spring Creek	Osage	3753	PC-TF	Expansion	July 1, 1972	4
Turtle Creek	St. Ansgar	1014	L			4
Ditch	Blue Grass	568	L			4
*Wapsipinicon River	McCausland	173	L			2
	Oxford Junction	725	L			2
	Olin	703	L			2
	Anamosa	4616	PC-TF			2,3
	Central City	1087	IT-TF			2,3
	Rowley	234	L			2
	Troy Mills SD		IT			2
	Independence	5498	PC-TF			2,3
	MH Institute		PC-TF			2
	Tripoli	1179	L			2
	Riceville	898	L			2
Silver Creek	DeWitt	3224	PC-TF			2
Clear Creek	Grand Mound	565	L			4
Mud Creek	Eldridge	583	IT-TF	Expansion	July 1, 1969	4
	Eldridge SW		L			4
Walnut Creek	Dixon	280	L			4
Yankee Run	Wheatland	643	AE-L			4
	Lowden	641	IT-TF			4
Calamus Creek	Calamus	435	L			4
Ditch	Lost Nation	567	L			4
Mill Creek	Clarence	859	IT-TF			4
Buffalo Creek	Coggon	672	PC-TF			4
	Winthrop	649	IT-TF			2
Otter Creek	Hazelton	665	AE-L			2
	Oelwein	8282	PC-TF	Expansion	July 1, 1972	4

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
Little Wapsipinicon River	Fairbanks	650	L			2
	Sumner	2170	PC-TF			2
Crane Creek	Dunkerton					
	Readlyn	547	AE-L			4
East Branch	Fredericksburg	797	PC-TF(2)			4
Little Wapsipinicon River	Elma	706	AE-L			4
Spring Branch	New Hampton	3456	PC-TF			4
Elk Creek	Alta Vista	276	IT-TF	Additions	July 1, 1972	4
Rock Creek	Lowmoor	343	L			
Elk River	Miles	376	AE-L			
Maquoketa River	Maquoketa	5909	PC			2,3
	Monticello	3190	PC-TF	Expansion	July 1, 1969	2
	Hopkinton	768	IT-TF	Expansion	July 1, 1972	2,3
	Delhi	464	L			2,3
	Manchester	4611	PC-TF	Expansion	July 1, 1969	2,3
	Maquoketa Valley Coop		TF-L	Additions	July 1, 1969	2
Deep Creek	Spragueville	100	AE-L			4
Copper Creek	Preston	960	L			4
North Fork	Cascade	1601	IT-TF	Replacement	July 1, 1968	2
	Worthington	360	AE-L			2
	Dyersville	3270	L			2
	Holy Cross	282	L			4
Whitewater Creek	Epworth	698	PC-TF			4
Bear Creek	Wyoming	797	L			4
Buck Creek	Ryan	347	L			4
Plum Creek	Earlville	668	IT-TF			4
South Fork	Lamont	554	L			4
Creek	Strawberry Point	1303	L			4
Little Maquoketa River	Farley	920	L			4
Turkey River	Elkader	1526	PC			2,3
	Elkader (Reimer Addit)		L			2,3

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
	Elgin	644	IT-TF			2
	Clermont	570	IT-TF			2
South Cedar Creek	Garnavillo	662	PC-TF			4
Volga River	Fayette	1597	PC-TF	Expansion	July 1, 1972	2
Bear Creek	Edgewood	767	IT-TF			4
Brush Creek	Arlington	614	PC-TF			4
North Branch	Hawkeye	516	PC-TF			4
Roberts Creek						4
Silver Creek	Monona	1346	PC-TF			4
Otter Creek	West Union-North	2551	IT-TF	Expansion	July 1, 1972	2
	South		PC-TF			2
Nutting Creek	Ossian SW	827	ST-SF			4
	SE		PC-TF			4
Creek	Calmar-SE	954	PC-TF			4
	Calmar-SW		PC-TF			4
Williams Creek	Postville	1554	PC-TF	Additions	July 1, 1968	4
Yellow River	Ossian-NE	827	ST-SF			2
	NW		ST-SF			4
Creek	Hygrade Food Products		L	Additions	July 1, 1968	4
Paint Creek	Waukon	3639	PC-TF			2
*Upper Iowa	Decorah	6435	PC-TF			2
	Lime Springs	581	PC-TF			2
Silver Creek	Cresco	3878	PC-TF	Additions	July 1, 1972	4

TABLE 11
(Continued)

WATER POLLUTION CONTROL NEEDS AND DESIGNATED WATER USES
(Revised June 1, 1968)

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT (1)	TREATMENT NEEDS	COMPLIANCE SCHEDULE (2)	WATER USE
MISSOURI RIVER BASIN						
*Missouri River Main Stem	Carter Lake	2287	(Omaha)			2
	Council Bluffs	55641	PC			1,2
	Terra Chemical Co.		WC			2
	Sioux City AF Base		L	Expansion	July 1, 1968	2
	Sergeant Bluff	813	(AF Base) -			2
	Sioux City	89159	PC			2
*Chariton River	Chariton	5042	PC-TF			2
Shoal Creek	Seymour-South		IT-SF	Replacement	July 1, 1972	4
	East		IT-SF	Replacement	July 1, 1972	4
Cooper Creek	Centerville-NE	6629	IT-TF	Additions		4
	West		IT-TF			4
South Fk Chariton R.	Humeston	638	L			4
Dry Run	Corydon-North	1687	L			4
	SE		L			4
	South		L			4
	SW		L			4
Ditch	Russell	577	L			4

(1) TREATMENT FACILITIES KEY

Imhoff Type	IT	Sand Filter	SF
Septic Tank	ST	Activated Sludge	AS
Primary Clarifier	PC	Extended Aeration	AE
Lagoon	L	Waste Control	WC
Trickling Filter	TF	Chlorination	C

(2) CONTRACT AWARD DATE

* Interstate Streams

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
*Mid Fk Medicine Creek	Allerton	692	IT-TF	Additions	July 1, 1968	4
*Weldon River						4
*Little River	Leon	2004	PC-TF			4
*Thompson River	Greenfield	2243	PC-TF			4
Twelve Mile Creek	Afton	773	L			4
*East Fork Big Creek	Lamoni	2173	L			4
East Fork Grand River						4
Mid Fork Grand River	Mount Ayr	1738	IT-TF			4
*Grand River						4
*Platte River	Creston		PC-TF			
*East Fork 102 River	Bedford	1807	PC-TF			1
	Lenox	1178	L			4
*Middle Fork 102 River						4
West Fork 102 River						4
*Nodaway River						2
East Nodaway River	Corning	2041	PC-TF	Expansion	July 1, 1972	2
West Nodaway River	Clarinda	5901	PC-TF			1,2
	Villisca	1690	PC-TF			2

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
	Massena	456	IT-TF			4
Middle Nodaway	Fontanelle	729	L			4
Seven Mile Creek	Cumberland	425	IT-TF			4
*West Tarkio						4
*Tarkio River	Stanton	514	ST-SF	Replacement	July 1, 1972	4
*Nishnabotna	Hamburg	1647	None	New Plant	July 1, 1968	2
East Nishnabotna	Farragut	495	L			2
	Shenandoah	6567	PC-TF			2
	Essex	767	L			2
	Red Oak	6421	PC-TF			2
	Elliott	459	L			2
	Griswold	1207	IT-TF			2
	Atlantic	6890	PC-TF			2
	Exira	1111	L			4
Indian Creek	Elk Horn	678	L			4
Turkey Creek	Anita	1233	L			4
Blue Grass Creek	Audubon	2928	PC-TF			4
West Nishnabotna	Macedonia	290	L			2
	Carson	583	PC-TF	New Plant	July 1, 1968	2
	Oakland	1340	None	New Plant	July 1, 1968	2
	Hancock	252	None	New Plant	July 1, 1969	2
	Harlan	4350	PC-TF			4
	Western Iowa Pork		LL	Expansion	July 1, 1969	4
	Irwin	425	L			4
	Manning	1676	IT-TF			4
Dry Run	Sidney	1057	IT-TF			4
Walnut Creek	Walnut	777	L			4

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
Silver Creek	Malvern	1193	None	New Plant	July 1, 1969	4
	Shelby	533	ST-SF	Replacement	July 1, 1972	4
Mid. Silver Creek	Treynor-West	476	L			4
	South		L			4
Indian Creek	Emerson	521	IT-TF			4
E Br W Nishnabotna	Avoca	1540	None	New Plant	July 1, 1969	2
W F W Nishnabotna	Manilla	939	L			4
Plum Creek	Tabor	909	AE			1
Keg Creek	Glenwood Packing Co.		WC	Closed		4
	Glenwood	4783	PC-TF			1
	State Hospital		PC-TF			4
	Minden	355	L			4
Mosquito Creek	Underwood	337	L			4
	Neola	870	IT-TF	Replacement	July 1, 1969	4
	Earling	431	AE			4
Boyer River	Logan	1605	None	New Plant	July 1, 1968	2
	Woodbine	1304	L			
	Dunlap	1254	L			2
	Dow City	531	L			2
	Denison	4930	None	New Plant	July 1, 1968	2
	Iowa Beef, Inc.		LL			2
	Farmbest, Inc.		L	Addition	July 1, 1968	2
	Wall Lake	812	ST-SF	Replacement	July 1, 1968	4
	Early	824	ST-SF	Replacement	July 1, 1969	4
Willow Creek	Missouri Valley	3567	L			4

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
East Fork Boyer	Vail	473	None	New Plant	July 1, 1969	4
	Westside	367	IT	Additions	July 1, 1972	4
Otter Creek	Kiron	251	IT-TF	Additions	July 1, 1972	4
Soldier Creek						
Spooner Ditch	Mondamin	436	L			4
Soldier River						
East Soldier	Ute	511	ST-SF	Replacement	July 1, 1972	4
	Charter Oak	665	ST-SF	Replacement	Oct. 1, 1968	4
Mid. Soldier	Ricketts	133	IT	Additions	July 1, 1972	4
Dry Run	Schleswig	785	L			4
*Little Sioux	Anthon	681	ST-SF	Replacement	July 1, 1972	2
	Correctionville	912	IT	Additions	July 1, 1970	2
	Washta	310	ST	Replacement	Sept. 1, 1968	2
	Quimby	369	ST	Replacement		2
	Cherokee	7724	PC-TF			2
	M. H. Institute		PC-TF			2
	Industrial Plant		LL			2
	Peterson	565	IT-TF			2
	Linn Grove	330	L	Replacement	July 1, 1972	2
	Sioux Rapids	962	IT-TF			2
	Spencer	8864	PC-TF	Expansion	July 1, 1968	2
Maple River	Mapleton	1686	ST-SF	Replacement	July 1, 1968	4
	Danbury	510	None	New Plant	July 1, 1968	4
	Battle Creek	786	None	New Plant	July 1, 1969	4
	Ida Grove	2265	PC-TF			4
	Galva	469	IT-TF	Additions	July 1, 1972	4
	Aurelia	904	IT-TF			4
Battle Creek	Holstein	1413	L			4

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
Odebolt Creek	Arthur	265	None	New Plant	July 1, 1968	4
	Odebolt	1331	PC-TF			4
Halfway Creek	Schaller	896	L			4
Little Maple	Alta	1393	PC-TF			4
WFk Little Sioux	Hornick	275	L			4
	Moville	1156	ST	Replacement	July 1, 1969	4
	Kinglsey	1044	L			4
Elliott Creek	Lawton	324	L			4
Fiddle Creek	Marcus	1307	PC-TF			4
Bacon Creek	Cushing	261	ST-SF			4
Pierson Creek	Pierson	425	IT-SF	Additions	July 1, 1972	4
Willow Creek	Cleghorn	228	L			4
Mill Creek	Meriden	192	L			4
	Paullina	1329	L			4
	Primghar	1131	L			4
Waterman Creek	Sutherland	883	L			4
Drainage Ditch	Ruthven	712	L			4
Ocheyedan River	Everly	668	IT	Replacement	July 1, 1969	2
	Ocheyedan	662	L			2
Drainage Ditch	Hartley	1738	PC-TF			4
Dry Run	Harris	258	IT-SF			4
Okoboji Outlet	Iowa Great Lake SD		PC-TF			1,2
	Milford	1476				1,2
	West Okoboji	171				1,2
	Arnolds Park	953				1,2
	Okoboji	330				1,2
	Wahpeton	117				1,2
	Spirit Lake	2685				1,2
	Orleans	200				1,2
WFk Little Sioux	Lake Park	952	L			4

STREAM AND TRIBUTARY	MUNICIPALITY OR INDUSTRY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
Monona-Harrison Ditch						4
McNeil Ditch	Blencoe	286	L			4
	Onawa	3176	PC-TF			4
Cleghorn Ditch	Whiting	595	L			4
	Sloan	704	IT-TF			4
Floyd River	Hinton	471	None	New Plant	July 1, 1968	4
	Merrill	645	None	New Plant	July 1, 1968	4
	Le Mars	7847	PC-TF			4
	Blue Ribbon		WC			4
	Alton	1048	L			4
	Orange City	2707	PC-TF			4
	Hospers	600	L			4
	Sheldon-Main	4251	PC-TF			4
	-West		L			4
W Br Floyd River	Maurice	237	IT	Additions	July 1, 1972	4
	Boyden	562	L			4
Mink Creek	Brunsville	128	L			4
Dry Run	Sioux Center	2275	PC-TF			4
Deep Creek	Oyens	114	L			4
	Remsen	1338	IT-TF			4
Willow Creek	Granville	381	IT-SF			4
Little Floyd River	Sanborn	1323	PC-TF			4
*Big Sioux River	Akron	1351	AE			4
	Hawarden	2544	None	New Plant	July 1, 1968	4
Indian Creek	Ireton	510	IT-TF			4
*Rock River	Rock Valley	1693	ST-SF	Replacement	July 1, 1969	2
	Rock Rapids	2780	PC-TF			2,3

STREAM AND TRIBUTARY	MUNICIPALITY	POPULATION	PRESENT TREATMENT	TREATMENT NEEDS	COMPLIANCE SCHEDULE	WATER USE
Burr Oak Creek	Hull	1289	PC-TF	Expansion	July 1, 1972	4
Little Rock River	Doon	436	IT	Replacement	July 1, 1972	4
	George	1200	ST-SF	Replacement	July 1, 1968	4
	Little Rock	564	IT-TF			4
Otter Creek	Ashton	615	L			4
	Sibley	2852	PC-TF	Expansion	July 1, 1969	4
Mud Creek	Alvord	238	L			4
	Lester	239	L			4
*Kanaranzi Ditch	Inwood	638	L			4
Blood Run Creek	Larchwood	531	L			4

TABLE 12

MUNICIPAL SEWERAGE SYSTEMS
(Based on 1960 population and special census)
December 31, 1967

	Total Number of Municipalities		Municipalities with Sanitary Sewers		Municipalities -- Treating Sewage		Total Population Treated to Total Sewered Population
Population	No.	Population	No.	Population	No.	Population	Percent
Over 15,000	22	1,063,477	22	1,063,477	22	1,063,477	100.0
2,000-15,000	110	511,527	109	504,754	107	496,483	98.4
1,000 -2,000	113	152,435	110	148,139	100	135,302	91.3
500 - 1,000	208	145,227	171	121,785	162	115,672	95.0
Under 500	494	119,882	87	30,352	81	28,122	92.7
TOTALS	947	1,992,548	499	1,868,507	472	1,839,056	98.4

NOTE: Two sanitary districts in unincorporated communities and two other unincorporated communities (Approximate Population of 1960 Persons) not included.

Compiled by
Environmental Engineering Service
Water Pollution Division
State Department of Health
Des Moines, Iowa

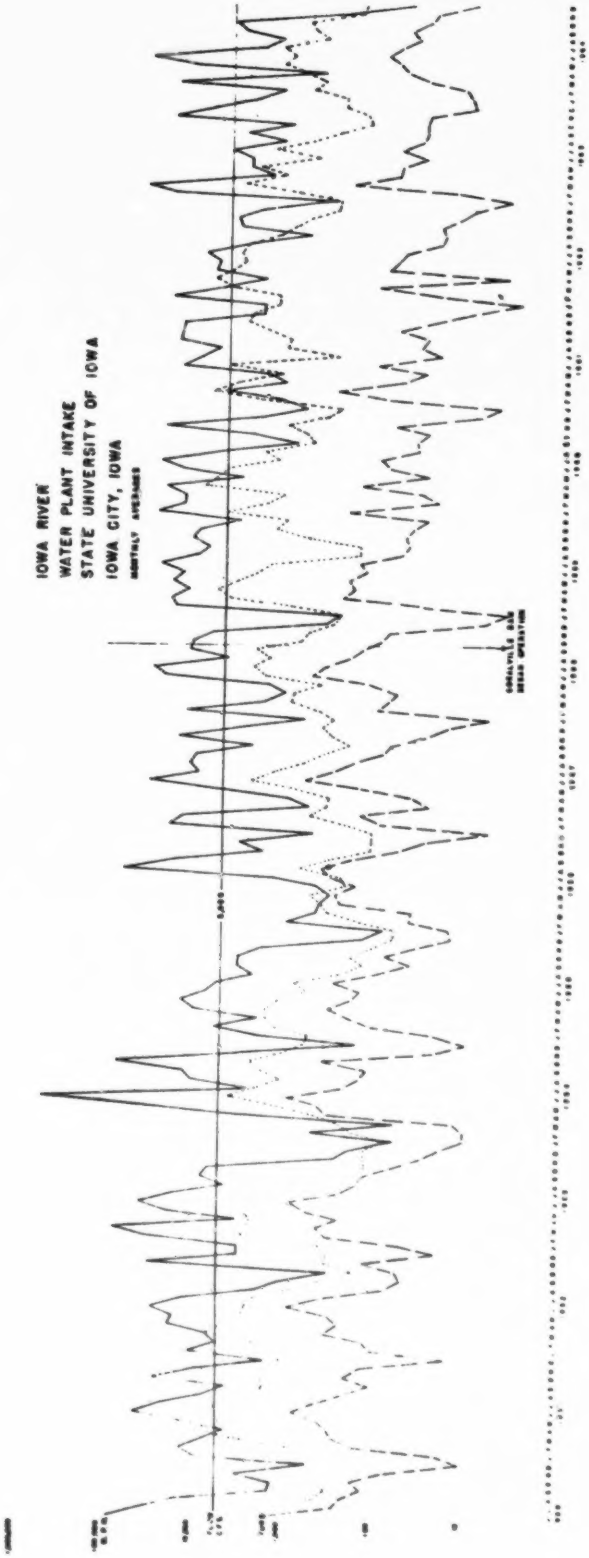

IOWA RIVER
WATER PLANT INTAKE
STATE UNIVERSITY OF IOWA
IOWA CITY, IOWA
MONTHLY AVERAGES
CORALVILLE DAM BEGAN OPERATION

FIGURE 1

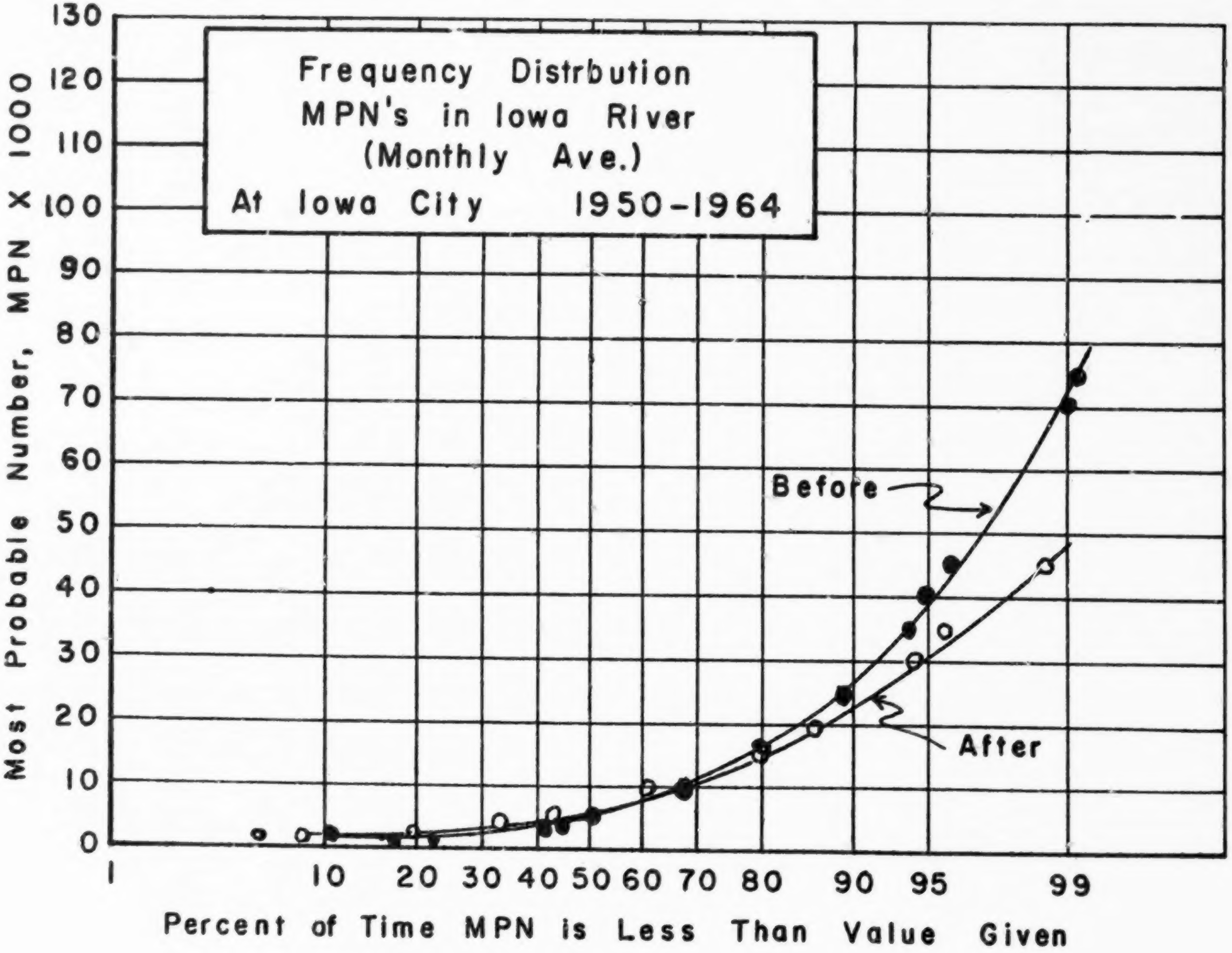
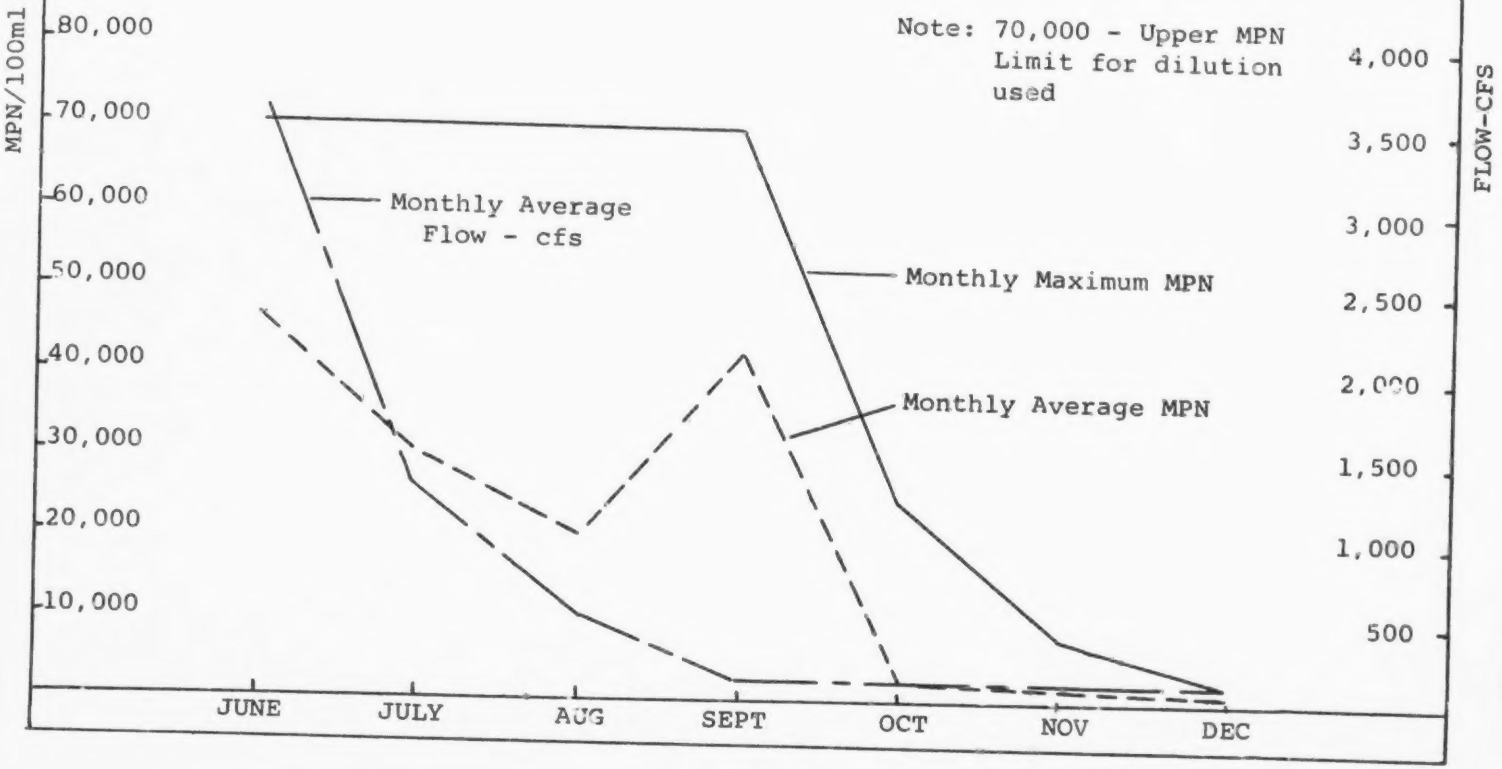

Frequency Distrbution
MPN's in Iowa River
(Monthly Ave.)
At Iowa City 1950-1964
Most Probable Number, MPN X 1000
130
120
110
100
90
80
70
60
50
40
30
20
10
0
1
10
20
30
40
50
60
70
80
90
95
99
Percent of Time MPN is Less Than Value Given
Before
After

Figure 2

FIGURE 3

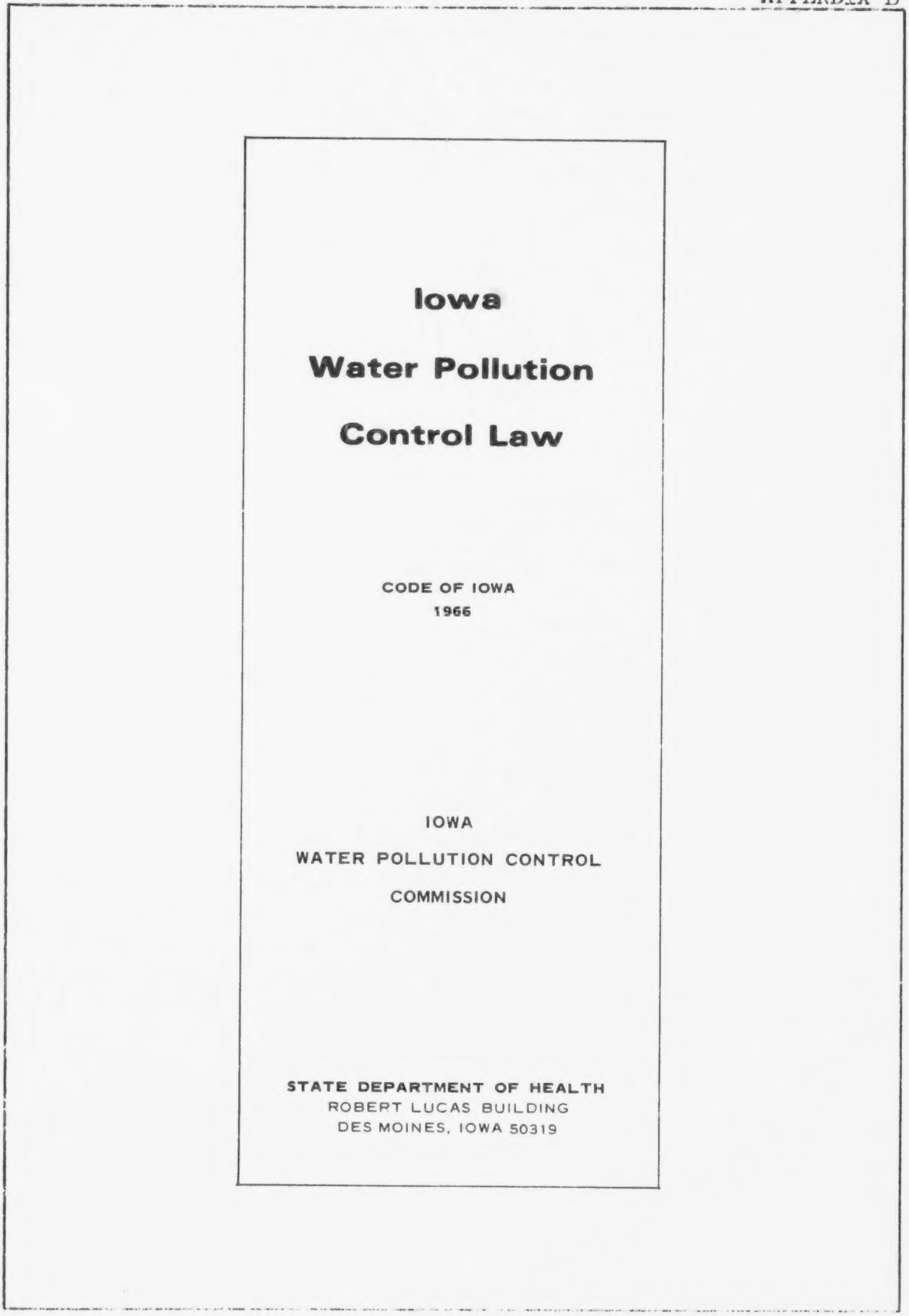
MPN COLIFORM ORGANISMS
RACCOON RIVER - DES MOINES
JUNE 15 - DECEMBER 31, 1953
(DAILY DETERMINATIONS)



Note: 70,000 - Upper MPN Limit for dilution used

CP53362 8'68 DI

APPENDIX B



Iowa
Water Pollution
Control Law

CODE OF IOWA
1966

IOWA
WATER POLLUTION CONTROL
COMMISSION

STATE DEPARTMENT OF HEALTH
ROBERT LUCAS BUILDING
DES MOINES, IOWA 50319

Address Communications To:
Iowa Water Pollution Control Commission
Iowa State Department of Health
Robert Lucas Building
Des Moines, Iowa 50319
Telephone 281-5345

CHAPTER 455B
WATER POLLUTION CONTROL

Referred to in §455.22
Pesticides, §206.3, subsection 2(d)

455B.1 Statement of policy.
455B.2 Definitions.
455B.3 Commission created.
455B.4 Membership.
455B.5 Terms.
455B.6 Vacancies—removal of member.
455B.7 Compensation.
455B.8 Organization.
455B.9 Powers and duties.
455B.10 Investigations.
455B.11 Orders.
455B.12 Scope of investigation.
455B.13 Quality standards.
455B.14 Permission to enter lands or waters.
455B.15 Hearings.
455B.16 Subpoena.
455B.17 Notice of hearing—orders—records.
455B.18 Appeal.
455B.19 Transcript on appeal.
455B.20 Stay order.
455B.21 Conclusiveness of action.
455B.22 Trial term.
455B.23 Injunction.
455B.24 Contempt—penalty.
455B.25 Unlawful acts.
455B.26 Plans of every disposal system to be filed.
455B.27 Assistance by governmental agencies.
455B.28 Discharge of waste into lakes.

455B.1 Statement of policy. Whereas the pollution of the waters of this state constitutes a menace to public health and welfare, creates public nuisances, is harmful to wildlife, fish and aquatic life, and impairs domestic, agricultural, industrial, recreational and other legitimate beneficial uses of water, and whereas the problem of water pollution in this state is closely related to the problem of water pollution in adjoining states, it is hereby declared to be the public policy of this state to conserve the waters of the state and to protect, maintain and improve the quality thereof for public water supplies, for the propagation of wildlife, fish and aquatic life, and for domestic, agricultural, industrial, recreational and other legitimate (beneficial) uses; to provide that no waste be discharged into any waters of the state without first being given the degree of treatment necessary to protect the legitimate (beneficial) uses of such waters; to provide for the prevention, abatement and control of new, increasing, potential, or existing water pollution; and to co-operate with other agencies of the state, agencies of other states and the federal government in carrying out these objectives. [61GA, ch 375,§1]

455B.2 Definitions. When used in this chapter:

1. "Sewage" means the water-carried waste products from residences, public buildings, institutions, or other buildings, including the bodily discharges from human beings or animals together with such ground water infiltration and surface water as may be present.

2. "Industrial waste" means any liquid, gaseous or solid waste substance resulting from any process of industry, manufacturing, trade or business or from the development of any natural resource.

3. "Other waste" means garbage, municipal refuse, lime, sand, ashes, offal, oil, tar, chemicals and all other substances which are not sewage or industrial waste which may pollute the waters of the state.

4. "Pollution" means the contamination of any waters of the state so as to create a nuisance or render such waters unclean, noxious or impure so as to be actually harmful, detrimental or injurious to public health, safety or welfare, to domestic, commercial, industrial, agricultural or recreational use or to livestock, wild animals, birds, fish or other aquatic life.

5. "Sewer system" means pipe lines or conduits, pumping stations, force mains and all other constructions, devices and appliances appurtenant thereto used for conducting sewage or industrial waste or other wastes to a point of ultimate disposal.

6. "Treatment works" means any plant, disposal field, lagoon, holding or flow regulating basin, pumping station, or other works installed for the purpose of treating, stabilizing or disposing of sewage, industrial waste or other wastes.

7. "Disposal system" means a system for disposing of sewage, industrial waste and other wastes and includes sewer systems, treatment works, and dispersal systems.

8. "Waters of the state" means all streams, lakes, ponds, marshes, watercourses, waterways, wells, springs, reservoirs, aquifers, irrigation systems, drainage systems, and all other bodies or accumulations of water, surface or underground, natural or artificial, public or private, which are contained within, flow through or border upon the state or any portion thereof.

9. "Person" means the state or any agency or institution thereof, any municipality, governmental subdivision, public or private corporation, individual, partnership, or other entity and includes any officer or governing or managing body of any municipality, governmental subdivision or public or private corporation.

10. "Commission" means the Iowa water pollution control commission. [61GA, ch 375,§2]

Referred to in §455B.23

455B.3 Commission created. There is hereby created and established the Iowa water pollution control commission. The commission is established as an agency of the state government to prevent, abate, or control the pollution of the waters of the state. [61GA, ch 375,§3]

455B.4 Membership. The commission shall consist of nine members as follows:

1. The commissioner of public health.

2. The director of the state conservation commission.

3. The director of the Iowa natural resources council.

4. A member from the staff of one of the universities or colleges of the state who has technical background, training and knowledge in the field of water pollution.

5. The secretary of agriculture.

6. Four electors of the state who shall be selected from the state at large solely with regard to their qualifications and fitness to discharge the duties of office without regard to their political affiliation. Of these four, one shall represent industry, one shall represent municipal government, one shall be an owner-operator farmer, and one shall represent the public at large. [61GA, ch 375,§4]

455B.5 Terms. The members of the commission not holding public office shall be appointed by the governor for overlapping terms of six years. The members of the first commission not holding public office shall be appointed for the following terms: two electors for a term to expire July 1, 1967; two electors for a term to expire July 1, 1969; and a member of one of the state universities for a term to expire July 1, 1971. Said terms shall begin immediately upon the appointment. Thereafter the term of each member of the commission shall be six years. [61GA, ch 375,§5]

455B.6 Vacancies—removal of member. Any vacancy or vacancies on the commission which may occur shall be filled by appointment by the governor for the unexpired portion of the regular term.

The governor may remove any member of the commission for malfeasance in office or for any cause that renders him ineligible for membership or incapable or unfit to discharge the duties of his office and his removal when so made shall be final. [61GA, ch 375,§6]

455B.7 Compensation. Each member of the commission, not otherwise in the full-time employment of any public body, shall receive the sum of twenty-five dollars for each day actually and necessarily employed in the discharge of official duties and each member of the commission shall be entitled to receive the amount of his traveling and other necessary expenses actually incurred while engaged in the performance of any official duties when so authorized by the commission. No member of the commission shall have any direct financial interest in any of the operations of the commission, nor may any member participate in making any decision in which he may have a personal interest. [61GA, ch 375,§7]

455B.8 Organization. The commission shall organize by the election of a chairman and other officers deemed necessary and the state department of health shall provide the services of a technical secretary to the commission and shall hold quarterly regular meetings each calendar year on the last Monday of each quarter and at such other times and places as it may deem necessary. The chairman and other officers shall be elected annually. Meetings may be called by the chairman at any time and shall be called as soon as possible by the chairman on the written request of four members of the commission. The majority of the commission shall constitute a quorum and the concurrence of a majority of the commission in any matter within its duties shall be required for its determination. [61GA, ch 375,§8]

455B.9 Powers and duties. The commission is hereby given and charged with the following powers and duties:

1. The commission through the state department of health shall have general supervision over administration and enforcement of all laws relating to the pollution of any water of the state, except as provided in section 135.11.

2. To develop comprehensive plans and programs for the prevention, control and abatement of new, increasing, potential, or existing pollution of the waters of the state.

3. The commission may cause the state department of health to conduct investigations

upon the written petition of:

a. The governing body of any city or town.

b. The local board of health.

c. The supervisors of any county.

d. Twenty-five residents of the state.

e. Any state agency or agencies.

4. To adopt, modify, or repeal such reasonable quality standards for any waters of the state in relation to the public use to which they are or may be put as it shall deem necessary for the purposes of this chapter.

Provided that where the quality of water is inter-related to the quantity of water the concurrence of the Iowa natural resources council shall be secured for the adoption, modification or repeal of such standards, prior to the effective date thereof.

5. To require plans and specifications for disposal systems or any part thereof to be submitted to them for approval or disapproval by the state department of health.

6. To direct the state department of health to issue, revoke, modify, or deny permits, under such conditions as it may prescribe for the prevention or abatement of pollution, for the discharge of sewage, industrial waste or other wastes or for the installation or operation of disposal systems or parts thereof.

7. Existing permits shall be recognized by the commission for the continuance of every disposal system now operating under legal authority. However, the commission may modify or revoke such permit in the same manner as other permits.

8. To prescribe rules and regulations for the conduct of the commission and other matters within the scope of the powers granted to and imposed upon it.

9. The commission shall co-operate with other state or interstate water pollution control agencies in establishing standards, objectives or criteria for quality of interstate waters originating or flowing through this state.

10. To hold such hearings as it may deem advisable and necessary for the discharge of its duties and to authorize any member, employee or agent to hold such hearings. [61GA, ch 375,§9]

See §§455A.25, subsection 3, 469.6 to 469.8 inc.

455B.10 Investigations. The state department of health shall conduct such investigations as may be necessary to carry out the provisions of this chapter. [61GA, ch 375,§10]

455B.11 Orders. The state department of health in accordance with the direction and policies of the commission may issue, modify, or revoke such orders as may be required for the prevention or discontinuance of the discharge of sewage, industrial waste or other wastes in any waters of the state resulting in pollution in excess of the applicable quality standard established by the commission. [61GA, ch 375,§11]

455B.12 Scope of investigation. Whenever an investigation is made, it shall be full and complete and may include such engineering studies, bacteriological, biological, and chemical analyses of the water and location and character of the source or sources of contamination as may be necessary. If pollution is found to exist, taking into consideration the criteria set forth in section 455B.13, the commission shall first notify the alleged offender and by informal negotiation attempt to resolve the problem and failing to do so within fourteen days, up to and during which time neither the commission, nor any member of the commission, nor its staff or employees shall make any public statement regarding the firm or individual as an alleged offender, shall then make an order fixing the time and place of hearing which shall be not later than twenty days thereafter. Such hearing shall be public and shall be conducted so far as possible in the same manner as a court hearing and every alleged offender shall have the right to appear, be represented by counsel, present testimony and examine witnesses. [61GA, ch 375, §12]

Examinations made by bacteriological laboratory, §263.8

455B.13 Quality standards. In adopting, modifying, or repealing quality standards for any waters of the state, the commission shall give consideration to:

1. The protection of the public health;

2. The size, depth, surface area covered, volume, direction and rate of flow, stream gradient, and temperature of the water;

3. The character and uses of the land area bordering said waters;

4. The uses which have been made, are being made, or may be made of said waters for public, private, or domestic water supplies, irrigation; livestock watering; propagation of wildlife, fish, and other aquatic life; bathing, swimming, boating, or other recreational activity; transportation; and disposal of sewage and wastes;

5. The extent of contamination resulting from natural causes including the mineral and chemical characteristics;

6. The extent to which floatable or settleable solids may be permitted;

7. The extent to which suspended solids, colloids, or a combination of solids with other suspended substances may be permitted;

8. The extent to which bacteria and other biological organisms may be permitted;

9. The amount of dissolved oxygen that is to be present and the extent of the oxygen demanding substances which may be permitted;

10. The extent to which toxic substances, chemicals or deleterious conditions may be permitted;

11. The need for standards for effluents from disposal systems. [61GA, ch 375,§13]

Referred to in §455B.12

455B.14 Permission to enter lands or waters. The commission, its agents, and employees of the state department of health may enter upon any lands or waters in the state and bordering on the state, for the purpose of making any investigation, examination, survey, or study concerning the quality or pollution of such waters. [61GA, ch 375,§14]

455B.15 Hearings. When the commission or state department of health conducts any hearing or investigation, any member of the commission or any employee or agent authorized in writing by the commission or employee of the state department of health may administer oaths, examine witnesses and issue, in the name of the commission, subpoenas requiring the attendance and testimony of witnesses and the production of evidence relevant to any matter involved in such hearing or investigation. Witnesses shall receive the same fees and mileage as in civil actions. [61GA, ch 375,§15]

455B.16 Subpoena. If any person refuses to obey a subpoena issued under this chapter, the district court of the county where the proceeding is pending shall have jurisdiction, upon application of the commission or its authorized member, employee, or agent, to issue to such person an order requiring him to appear and testify or produce evidence and any failure to obey such order of the court may be punished by said court as a contempt thereof. [61GA, ch 375,§16]

455B.17 Notice of hearing—orders—records.

1. Notice of the time and place of hearing shall be served upon each alleged offender at least ten days before said hearing. Such notice shall be in the manner required for the service of notice of the commencement of an ordinary action in a court of record.

2. Notwithstanding the provisions of subsection 1 the commission or state department of

health, when it has first been determined that an emergency exists respecting any matter affecting or likely to affect the public health, may make a temporary order without notice and without hearing. A copy of such temporary order shall be served as provided in subsection 1. Any such temporary order entered by the commission or the state department of health, shall be binding and effective immediately until such order is reviewed by a hearing or is modified or reversed by the court.

3. After such hearing the commission may, if it finds the alleged offender is guilty of the charges, enter an order directing such person to desist in the practice found to be the cause of such pollution, taking into account the use to which the water is being or may be put or the commission upon the recommendation of the state department of health may order a change in the method of discharging sewage, industrial wastes and other wastes into the water so that the same will not result in pollution and the method shall be in compliance with the effluent or water quality standards adopted by the commission.

4. If any such change is ordered, unless such practice is rendering such water dangerous to the public health, a reasonable time shall be granted to the offender in which to put in use the method ordered.

5. The commission shall keep a complete record of such proceedings, including all the evidence taken, and such record shall be open to public inspection. However, it shall be unlawful for any person in connection with his duties or employment by the commission, to make public or give any information relating to secret processes or methods of manufacture or production at any public hearing or otherwise, and all such information shall be kept strictly confidential. [61GA, ch 375,§17]

455B.18 Appeal. An appeal may be taken by any aggrieved party from any order entered in such proceedings to the district court of the county in which the alleged offense was committed or such final order was entered. Such appeal shall be perfected by serving a written notice on the chairman of the commission within thirty days of the entry of such order. The hearing on appeal shall be tried as a suit in equity and shall be de novo. The court may receive additional testimony and may affirm, modify or reverse the order of the commission. The setting aside of such order by the court shall not preclude the commission from again instituting proceedings against the same person if the commission feels that the public health is endangered. [61GA, ch 375, §18]

455B.19 Transcript on appeal. Within thirty days after an application for an appeal is filed with the commission, it shall make, certify and file in the office of the clerk of the court to which an appeal is taken a full and complete transcript of all documents and papers relating to the case including a copy of the order, rule, regulation or decision appealed from and a copy of any findings of fact, rulings or conclusions of law made by the commission in the matter. [61GA, ch 375,§19]

455B.20 Stay order. Action of the commission shall not be stayed by an appeal except by order of the court for good cause shown by the appellant. The granting of a stay may be conditioned upon the furnishing by the appellant of such reasonable security as the court may direct. A stay may be vacated on application of the commission or any other party after hearing by the court. [61GA, ch 375,§20]

455B.21 Conclusiveness of action. If no appeal is taken from an order, rule, regulation, or other decision of the commission as provided by this chapter, or if the action of the commission is affirmed on appeal, the action of the commission in the matter involved shall be deemed conclusive and the validity and reasonableness thereof shall not be raised in any other action or proceeding, but this shall not preclude the commission from modifying or rescinding its action. [61GA, ch 375,§21]

455B.22 Trial term. The first term after appeal is taken shall be the trial term. [61GA, ch 375,§22]

455B.23 Injunction. Any person, firm, corporation, municipality, or any officer or agent thereof causing pollution as defined in section 455B.2 of any waters of the state or placing or causing to be placed any sewage, industrial waste, or other wastes in a location where they will probably cause pollution of any waters of the state may be enjoined from continuing such action.

It shall be the duty of the attorney general, only upon the request of the commission, to bring an action for an injunction against any person, firm, corporation, municipality, or agent thereof violating the provisions of this section. In any such action, any previous findings of the commission after due notice and hearing shall be prima-facie evidence of the fact or facts found therein. [61GA, ch 375,§23]

455B.24 Contempt—penalty. Failure to obey any order issued under the provisions of this chapter made by the commission with reference to matters pertaining to the pollution of waters of the state shall constitute prima-facie evidence of contempt. In such event the commission may certify to the district court of the county in which such alleged disobedience occurred the fact of such failure. The district court after notice, as prescribed by the court, to the parties in interest shall then proceed to hear the matter and if it finds that the order was lawful and reasonable it shall order the party to comply with the order. If the person fails to comply with the court order, he shall be punished for contempt.

Any person, firm, corporation, or any officer or agent thereof found guilty of contempt under this section shall be fined in a sum not to exceed one hundred dollars for each offense. The penalties provided in this section shall be considered as additional to any penalty which may be imposed under the law relative to nuisances or any other statute relating to the pollution of waters of the state and a conviction under this section shall not be a bar to prosecution under any other penal statute. [61GA, ch 375,§24]

455B.25 Unlawful acts.

1. It shall be unlawful to carry on any of the following activities without first securing a written permit from the state department of health as may be required by the commission for the disposal of all sewage, industrial waste, or other wastes which are or may be discharged into the waters of the state.

a. The construction, installation or modification of any disposal system or part thereof or any extension or addition thereto.

b. The construction or use of any new outlet for the discharge of any sewage or wastes directly into the waters of the state. However, no permit shall be required for any new disposal system or extension or addition to any existing disposal system that receives only domestic or sanitary sewage from a building, housing or occupied by fifteen persons or less.

2. Plans and specifications for any waste disposal system covered by subsection 1 of this section shall be submitted to the commission before a written permit may be issued and the construction of any such waste disposal system shall be in accordance with plans and specifications as approved by the state department of public health. If it is necessary or desirable to make material changes in such plans or specifications, revised plans or specifi-

cations together with reasons for the proposed changes must be submitted to the commission for a supplemental written permit.

Any person convicted of violating this section shall be fined in a sum not to exceed one thousand dollars. [61GA, ch 375,§25]

455B.26 Plans of every disposal system to be filed. The commission may require the owner of a waste disposal system, discharging sewage or wastes into any of the waters of the state to file with it complete plans of the whole or any part of such system and any other information and records concerning the installation and operation of such system. [61GA, ch 375,§26]

455B.27 Assistance by governmental agencies. The commission and the state department of health may request and receive from any department, division, board, bureau, commission, public body, or agency of the state, or of any political subdivision thereof, or from any organization, incorporated or unincorporated, which has for its object the control or use of any of the water resources of the state, such assistance and data as will enable the commission or department to properly carry out its activities and effectuate its purposes under the provisions of this chapter. The commission or department shall reimburse such agencies for special expense resulting from expenditures not normally a part of the operating expenses of any such agency. [61GA, ch 375,§27]

455B.28 Discharge of waste into lakes. No sewage, industrial waste or other wastes whether treated or untreated shall be discharged directly into any state-owned natural or artificial lake but this section shall not be construed to prohibit the discharge of adequately treated sewage or industrial wastes into a stream tributary to a lake upon the written permission of the commission. [61GA, ch 375,§28]

Appropriation, 61GA, ch 375,§35

MISCELLANEOUS PROVISIONS

135.11 Powers and duties. The commissioner of public health shall be the head of the "State Department of Health", which shall:

7. Make inspections of the public water supplies, sewer systems, sewage treatment plants, and garbage and refuse disposal plants throughout the state, and direct the method of installation and operation of the same.

455A.25 When permit required. For the purpose of administering sections 455A.19 to 455A.32, inclusive, a permit as herein provided shall be required for the following:

3. Any person who diverts water or any material from the surface directly into any underground watercourse or basin. Provided, however, that any diversion of water or material from the surface directly into any underground watercourse or basin existing upon May 16, 1957 shall not require a permit if said diversion does not create waste or pollution. No permit shall be issued under this subsection until the approval of the Iowa water pollution control commission has been obtained.

469.6 Certificate of approval. No permit shall be granted for the construction or operation of a dam where the water is to be used for manufacturing purposes, except to develop power, until a certificate of the Iowa water pollution control commission has been filed with the council showing its approval of the use of the water for the purposes specified in the application. [C24, 27, 31, 35, 39,§**7772**; C46, 50, 54, 58, 62,§469.6; 61GA, ch 375,§30]

Iowa water pollution control commission, ch 455B

469.7 Application for certificate. When it is proposed to use the water for manufacturing purposes, except to develop power, or for condensation purposes, application must be made to the Iowa water pollution control commission, accompanied by a description of the proposed use of the water and what, if any, substances are to be deposited in such water and chemical changes made in the same, and such other information as the department of health may require to enable it to determine the advisability of the issuance of such certificate. [C24, 27, 31, 35, 39,§**7773**; C46, 50, 54, 58, 62,§469.7; 61GA, ch 375,§31]

40ExGA, SF 186,§4, editorially divided
Iowa water pollution control commission, ch 455B

469.8 Granting or refusing. If the Iowa water pollution control commission is satisfied that the use of the water in any such project will not cause pollution of the same or render it materially unwholesome or impure, or deleterious to fish life, it may issue a certificate. and if it is not so satisfied, it shall refuse to issue same. [C24, 27, 31, 35, 39,§**7774**; C46, 50, 54, 58, 62,§469.8; 61GA, ch 375,§32]

Iowa water pollution control commission, ch 455B

ADDRESS COMMUNICATIONS TO:

Iowa Water Pollution Control Commission
Iowa State Department of Health
Robert Lucas Building
Des Moines, Iowa 50319
Telephone 281-5345

END

CP50043 11/67

☆ U. S. GOVERNMENT PRINTING OFFICE : 1969 O - 352-980